May 6, 1957 50 cents

AVIATION WEEK

A McGRAW-HILL PUBLICATION

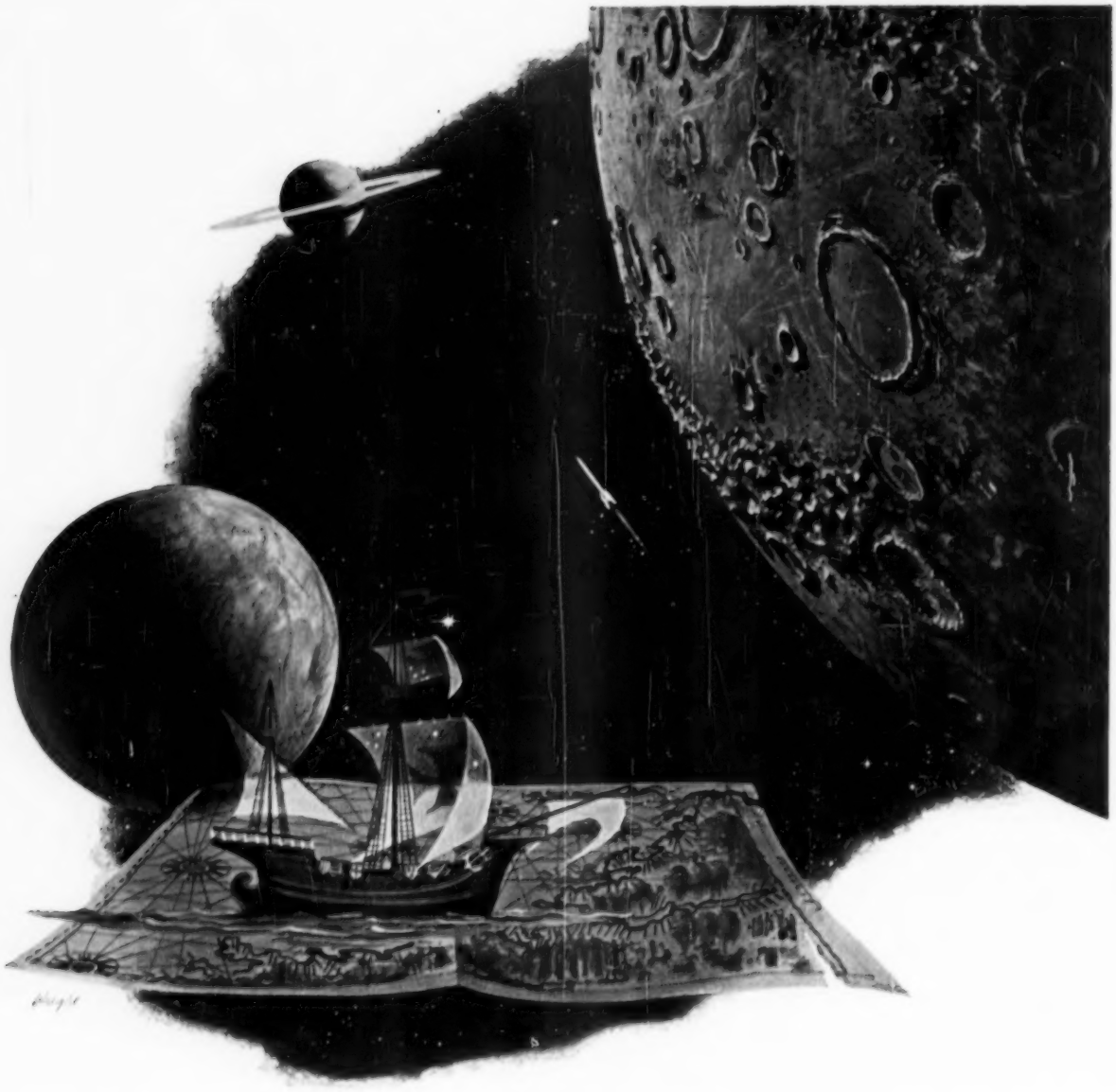
Avionic Companies Join to Compete

•

Supersonic Escape Barrier Breached

Orenda Iroquois B-47 Test Bed

Martin P6M SeaMaster Crash Report



Widening mankind's horizon by conquering

WIDE OPEN SPACES

Men of vision, making the unknown known, have widened man's horizon—advanced civilization. From the great *sixteenth century* exploration of the earth, its oceans, lands and peoples, came knowledge now in everyday use. Today at **CONVAIR**-*Astronautics*, scientists and engineers have already embarked on the greatest challenge of the *twentieth century*—man's conquest of the uncharted, unknown and infinite universe. Knowledge gained from solving the mysteries of space will bring mankind untold benefits.

CONVAIR

A DIVISION OF GENERAL DYNAMICS CORPORATION

CONVAIR-*Astronautics, is building a new facility at San Diego, California, which will be devoted to research, development, manufacturing and preliminary testing of the U.S. Air Force's Atlas Intercontinental Ballistic Missile, as well as other projects looking into the future of astronautics.*

CHRIST OF THE ANDES

New star beneath the southern cross

Soon South America will look up to the new Fairchild F-27 transport already ordered by South American airlines.

This exciting new propjetliner promises to become as popular in the Southern Hemisphere as it is in the North American continent. Its special qualities make it ideal for regional airlines, and a valuable addition to corporate aircraft fleets as well.

The F-27 is fast—cruises at 280 mph on the power of airline-proven propjet engines. The cabin is pressurized to permit flight over Andes peaks and Pampas plains with equal ease. Small field performance puts most back-country strips within easy F-27 reach.

Tops in versatility, high on performance, the F-27 is low in cost—it's inexpensive to fly, to maintain, to buy.

Address inquiries to: R. James Pfeiffer, Executive Director of Customer Relations, Fairchild Engine & Airplane Corporation, Hagerstown 15, Maryland.

FAIRCHILD

F-27

THE FINEST AIRCRAFT FOR AIRLINES, CORPORATIONS AND MILITARY SERVICES.

AVIATION CALENDAR

May 6-8—28th Annual Meeting, Aero Medical Assn., Shirley Savoy Hotel, Denver.

May 7-9—Electrical Engineering Aspects of Aircraft and Missiles, American Institute of Electrical Engineers, Biltmore Hotel, Dayton, Ohio.

May 7-9—Spring Assembly, Radio Technical Commission for Aeronautics, Ambassador Hotel, Los Angeles, Calif.

May 7-9—Annual Technical Convention, Committee on Air Transportation, American Institute of Electrical Engineers, Biltmore Hotel, Dayton, Ohio.

May 8-11—13th Annual National Forum, American Helicopter Society, Sheraton Park Hotel, Washington, D. C.

May 9-10—Microwave Ferrites and Related Devices and Their Applications, Western Union Auditorium, N. Y. C.

May 13-14—What the Rocket and Missile Program Means to the Chemical Industry, Spring Meeting, Commercial Chemical Development Assn., French Lick, Ind.

May 13-15—National Conference on Aeronautical Electronics, Sponsored by the Institute of Radio Engineers, Dayton, Ohio.

May 14—Engine Operation & Maintenance Forum sponsored by Pratt & Whitney Aircraft Division and distributors, Pacific Airmotive Corp., Cosmopolitan Hotel, Denver, Colo. Others sessions, May 17 at Ambassador Hotel, Burbank, Calif.; May 20 at Hotel Claremont, Oakland, Calif., and May 22, New Washington Hotel, Seattle, Wash.

May 15-17—Jet Age Airport Conference, Air Transport Division, American Society of Civil Engineers, Park-Sheraton Hotel, New York.

May 16-17—Airline Editors Conference, Air Transport Assn., ATA Conference Rm., Washington, D. C.

May 20-22—1957 Design Engineering Conference, American Society of Mechanical Engineers, Coliseum, New York.

May 20—Annual Meeting and award of Daniel Guggenheim Medal, University Club, 1 W. 54 St., New York.

(Continued on page 6)

AVIATION WEEK • MAY 6, 1957

Vol 66, No. 18

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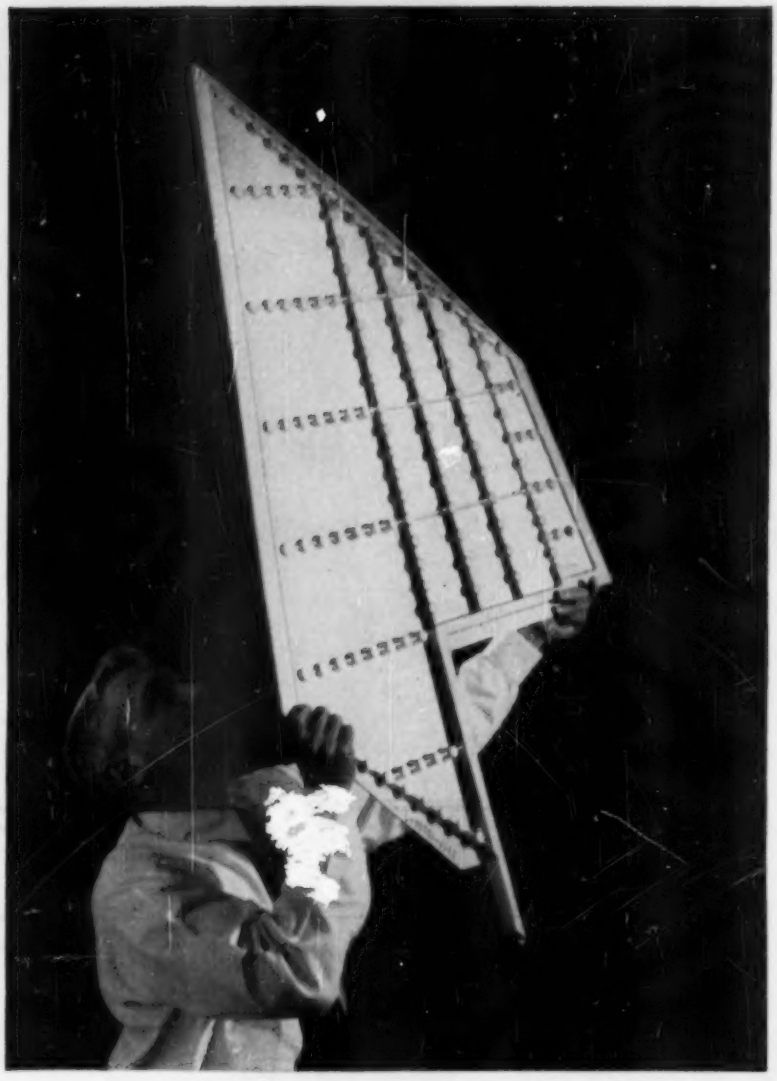


THIN-WALL magnesium casting for the Regulus missile fin produced by Dow.

QUALITY MAGNESIUM CASTINGS

for aircraft and missiles

Sand, Permanent Mold, Plaster Castings

YOU NAME THE CASTING. Dow can supply you with ordinary and extraordinary shapes or sizes. Specialized techniques rigidly maintain your standards and specifications. Heavy-wall or thin-wall, room or elevated temperature use, the best—and surest—answer to your problems is Dow magnesium castings! Contact your nearest Dow sales office for additional information. THE DOW CHEMICAL COMPANY, Foundry Sales, Bay City, Michigan.

YOU CAN DEPEND ON DOW

FROM BRIDE TO BIRDWOMAN

Alys McKey Bryant, one of America's first woman pilots, one-time holder of the woman's altitude record, and an aerial performer of note.

(Photos Courtesy National Air Museum, Smithsonian Institution)

ALYS MCKEY met John Milton Bryant the day she helped pull him from a crashed airplane. In the days that followed, while she called on the young pilot during his recovery, she became more and more interested in flying.

So, in December, 1912, Alys learned to fly. She then married John Bryant and joined him in an aerial flying act, billed as "The Bennett Flyers." The Bryants became one of the most prominent flying teams in the Pacific Northwest, appearing at fairs, carnivals and specially arranged meets.

Mrs. Bryant flew under her maiden name and established a number of records, including the woman's altitude record, and was one of the first women to fly in Canada. John Bryant was a notable flyer of the era, as was his brother Frank, a third member of the troupe.

After her barnstorming days were over, Mrs. Bryant became connected with the Benoist Company, manufacturer of flying boats. During World War I she worked with the Goodyear Company in the development and construction of airships.

A pioneer in research and development of aviation fuels, Phillips Petroleum Company is, today, a foremost supplier of high octane gasoline for commercial, private and military aircraft.

In step with the future, Phillips is a leading producer of *super-performance* Jet Fuels for the latest designs in turbo-props and jets. And Phillips research continues to lead the way for development of fuels for the aircraft of tomorrow.

AVIATION DIVISION • PHILLIPS PETROLEUM COMPANY • BARTLESVILLE, OKLAHOMA

AVIATION CALENDAR

(Continued from page 4)

May 20—Sixth Annual Aviation Fire Safety Seminar, National Fire Protection Assn., Hotel Statler, Los Angeles, Calif.

May 24-June 2—22nd Paris Air Show, Society of French Aircraft Constructors, LeBourget Airport, Paris.

May 28-29—Annual Business Aircraft Safety Seminar, sponsor by Flight Safety Foundation, Park Sheraton Hotel, New York.

May 30-June 2—Wright Memorial Glider Meet, sponsored by Soaring Society of Dayton, Cox Municipal Airport, Dayton.

June 1—8th Annual Maintenance and Operations Meeting for Business and Executive Aircraft Owners, sponsored by Reading Aviation Service, Reading Municipal Airport, Pa.

June 3-5—First General Aviation Law-Science Seminar, Wichita University, Kans.

June 4-5—Symposium on Materials for Electronic Components, University of Pennsylvania, Philadelphia, Pa.

June 6-7—National Symposium on (Electronic) Production Techniques, Willard Hotel, Washington, D. C.

June 8-12—Technical Personnel Recruiting Exposition, in conjunction with National Technical Career Conference, Sherman Hotel, Chicago, Ill.

June 9-14—Semi-Annual Meeting, American Society of Mechanical Engineers, Sheraton Palace Hotel, San Francisco, Calif.

June 10-14—Lecture Series on Vacuum Metallurgy, sponsored by New York University College of Engineering. Address inquiries to: Dr. R. F. Bunshah, N. Y. University College of Engineering, University Heights 53, N. Y.

June 11-13—3rd Western Plant Maintenance & Engineering Conference, Civic Auditorium, San Francisco, Calif.

June 14—Plastics for Electronics, New England Section, Society of Plastics Engineers, Lowell Technological Institute, Lowell, Mass.

June 17-19—National Convention on Military Electronics, Sheraton-Park Hotel, Washington, D. C., sponsored by Institute of Radio Engineers.

June 17-20—Eighth All Women's International Air Race, McAllen, Tex.-Cuba. For details, write: Miss Irma Price, Entry Chief, 242 W. 8th St., Miami, Fla.

June 17-20—National Summer Meeting, Institute of the Aeronautical Sciences, Biltmore Hotel, Los Angeles, Calif.

June 23-25—29th Annual Meeting, Aviation Distributors & Manufacturers Assn., The Broadmoor, Colorado Springs, Colo.

June 24—Soviet National Aviation Day, Moscow.

July 12-13—British Lockheed International Aerobatic Competition, the National Air Races (third round) and the King's Cup Air Race, Coventry Civil Aerodrome, Bagington, England.

Aug. 20-23—Western Electronic Show & Convention, Cow Palace, San Francisco.

Sept. 1-6—Sixth International Aeronautical Conference, Royal Aeronautical Society and Institute of the Aeronautical Sciences, Folkstone and London, England.

Sept. 2-8—1957 Flying Display, Society of British Aircraft Constructors, Farnborough, England.

NEW

Trans-Sonics*

"TAPE-ON" SURFACE TEMPERATURE RESISTORS

for Temperature Telemetering

- NO THICKER THAN A PIECE OF TAPE
- OUTPUT UP TO 5 VOLTS WITHOUT AMPLIFICATION
- AVAILABLE IN VARIOUS RANGES FROM −300° to +400°F.
- RESISTANCE CHANGE OF 100 OHMS OVER SPECIFIED RANGE
- NO HOLES TO DRILL — QUICK AND EASY "TAPE-ON" INSTALLATION

Trans-Sonics Type 1371 "Tape-on" Surface Temperature Resistors are precision resistance thermometers with a platinum resistance winding as the sensing element. These resistors which are no thicker than a piece of tape may be applied to *any surface* whose temperatures are to be measured. In a commutation circuit, they modulate standard telemetering transmitters without amplification. The new Type 1371 "Tape-on" Surface Temperature Resistors may be added to an installation using other Trans-Sonics temperature transducers without any further circuit modification. Each resistor is furnished with 6" long fibreglas-covered constantan leads. Write for Bulletin 1371 to Trans-Sonics, Inc., Dept. 7.

*Reg. Trademark

SPECIFICATIONS

SIZE: ¼" x 5/16"

Accuracy: ±2% of full scale range

Precision: ±0.5% of full scale range

Maximum Continuous Current: 20 ma rms (averaged over 1 second)

Environmental Operation Conditions

Vibration: 1" double amplitude, 0 to 22 cps ± 25g, 22 to 2000 cps

Shock: 100g in any direction, per paragraph 4.15.1 of MIL-E-5272A (10 milliseconds shock)

INSTANT INSTALLATION

As easy to apply as a thumb print.

For Transducers, See Trans-Sonics

Trans-Sonics, Inc.

P. O. BOX 328 LEXINGTON 73, MASSACHUSETTS

Equipped to handle −80°F. to 400°F. with AUTO-LITE 350 WIRE

Wide scale, high speed jet travel will be a reality with the new Lockheed propjet Electra. The Electra will be powered by thrifty and quiet Allison engines. These engines reduce frontal area and engine weight by one-half over piston engines of equal horsepower. The Electra is capable of reaching an altitude of 30,000 feet faster than any propeller-driven airliner in service, and is specified to use Auto-Lite 350 Wire in many critical applications. Like many other airframe manufacturers, Lockheed finds the extra temperature range performance of Auto-Lite 350 Wire ideally suited to jet aircraft demands. In addition to its high resistance to abrasion, flame, solvents, fuels, and lubricants, many manufacturers find that Auto-Lite 350 Wire reduces production costs compared with other high-temperature wires.

- Flexible at temperatures below −80°F.
- Smokeless
- No discoloration at maximum operating cable temperatures
- Free stripping
- Flame-resistant
- In normal installations, this wire is satisfactory at −80°F., or at an altitude of 60,000 ft. as measured at the equator
- Resistant to modern aircraft hydraulic fluids, lubricants and fuels for both reciprocating and jet-type engines
- Manufactured in sizes 22 thru 2/0
- Easy printing of circuits with conventional marking machines
- Meets Spec. MIL-W-8777, U.S.A.F.

For complete information on Auto-Lite Aircraft Wire, including specifications and samples, write to . . .
The Electric Auto-Lite Company, Wire and Cable Division, Port Huron, Michigan • Hazleton, Pennsylvania

AUTO-LITE® 350 GENERAL PURPOSE HIGH-TEMPERATURE AIRCRAFT WIRE

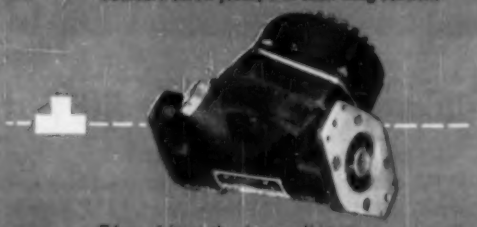
WESTERN GEAR SYSTEMS FLY WITH NEW LOCKHEED MODEL 1649 LUXURY LINER!

Trim tab actuators in elevators, ailerons and outboard rudders.

Inboard screw jacks, 2 in each wing section.

Reported world's longest range airplane, Lockheed's Model 1649 luxury liner can fly 6,300 miles non-stop without tapping fuel reserves. Wingspan of 150' is longest of any transport plane. Takeoff weight 78 tons. Cruising speed 350 MPH. Total horsepower 13,600.

Outboard screw jacks, 2 in each wing section.



T-box, 4 in each wing section.

Western Gear's wing flap system on Lockheed's newest and largest luxury liner, Model 1649, using ball screws to actuate 335 sq. ft. of wing flap area, helps in takeoff and landing. Western Gear trim tab controls on both outboard rudders, elevators and ailerons aid in maintaining steady, true flight.

Assignment to design and construct such important control systems is evidence of Lockheed faith in Western Gear. Western Gear equipment is aboard virtually every major aircraft flying today, both commercial and military. Take advantage of 40 years of service to the aviation industry. Call on a Western Gear aircraft specialist for recommendations. Address General Offices, Western Gear, P.O. Box 182, Lynwood, California.

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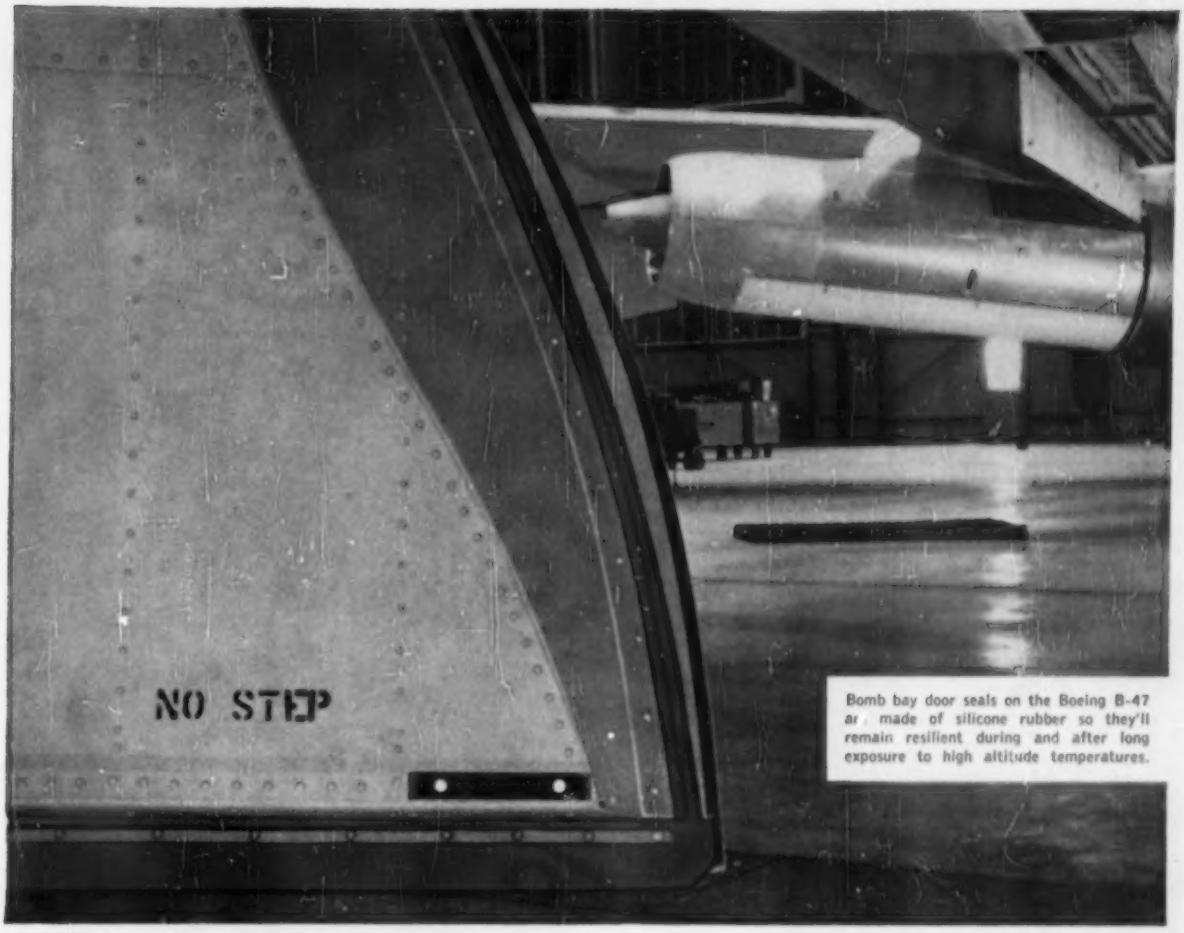
ENGINEERS AND MANUFACTURERS

PLANTS AT LYNWOOD, PASADENA, BELMONT, SAN FRANCISCO (CALIF.) SEATTLE AND HOUSTON — REPRESENTATIVES IN PRINCIPAL CITIES



Bomb bay door seals on the Boeing B-47 are made of silicone rubber so they'll remain resilient during and after long exposure to high altitude temperatures.

SILASTIC SILICONE RUBBER seals stay rubbery at −130 F

Silastic*, Dow Corning's silicone rubber, shows little or no change in strength, hardness or resilience despite prolonged exposure to temperatures ranging from −130 to over 500 F. That's why Silastic provides the ultimate in all-weather sealing efficiency. Silastic extruded parts are available in almost any color, size or shape from leading rubber companies.

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*T.M. REG. U.S. PAT. OFF.

Typical Properties of Silastic for Seals

• Temperature range, °F	−130 to 500
• Tensile strength, psi	600 to 900
• Elongation, %	150 to 300
• Tear strength, lb/in	40 to 75
• Compression set, %, @ 300 F	25 to 50
• Hardness range, Durometer	20 to 80
• Weather, ozone and corona resistance	Excellent

If you consider ALL the properties of a silicone rubber, you'll specify SILASTIC.

first in silicones — DOW CORNING SILICONES

DOW CORNING CORPORATION • MIDLAND, MICHIGAN

how specs have changed!

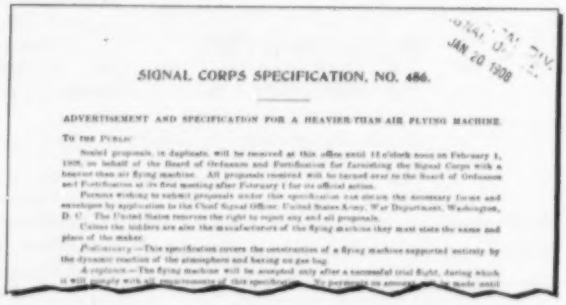
The following was a Department of War specification issued on December 23, 1907, for a "heavier-than-air" flying machine:

> **"Before acceptance a trial endurance flight will be required of at least one hour, during which time the flying machine must remain continuously in the air without landing. It shall return to the starting point and land without any damage that would prevent it immediately starting on another flight. During this trial flight of one hour it must be steered in all directions without difficulty, and at all times under perfect control and equilibrium."**

Those were tough problems and tough specs in 1907. Specs are still tough—take Convair's new B-58 "Hustler", for instance. L·O·F's work in the development of laminated safety glass with Dow Corning silicone interlayer material has made it possible for this airplane to reach a performance standard heretofore undreamed of for this type of aircraft.

If you have any question concerning the latest developments in aircraft glass, write it out and send it to Aircraft Division, Libbey·Owens·Ford Glass Company, 608 Madison Avenue, Toledo 3, Ohio.

ALSO ASK FOR A COPY OF *The Original American Army Contract for Aeroplanes* suitable for framing.



SIGNAL CORPS SPECIFICATION, NO. 486.

ADVERTISEMENT AND SPECIFICATION FOR A HEAVIER-THAN-AIR FLYING MACHINE.

To the Public:

Sealed proposals, in duplicate, will be received at this office until 12 o'clock noon on February 1, 1908, on behalf of the Board of Ordnance and Fortification for furnishing the Signal Corps with a heavier than air flying machine. All proposals received will be turned over to the Board of Ordnance and Fortification at its first meeting after February 1 for its official action.

Persons wishing to submit proposals under this specification can secure the necessary forms and envelopes by application to the Chief Signal Officer, United States Army, War Department, Washington, D. C. The United States reserves the right to reject any and all proposals.

Unless the bidders are also the manufacturers of the flying machine they must state the name and place of the maker.

Preliminary.—This specification covers the construction of a flying machine supported entirely by the dynamic reaction of the atmosphere and having no gas bag.

Acceptance.—The flying machine will be accepted only after a successful trial flight, during which it will comply with the requirements of this specification. No payments on account will be made until

LOF GLASS

LIBBEY·OWENS·FORD *a Great Name in Glass*

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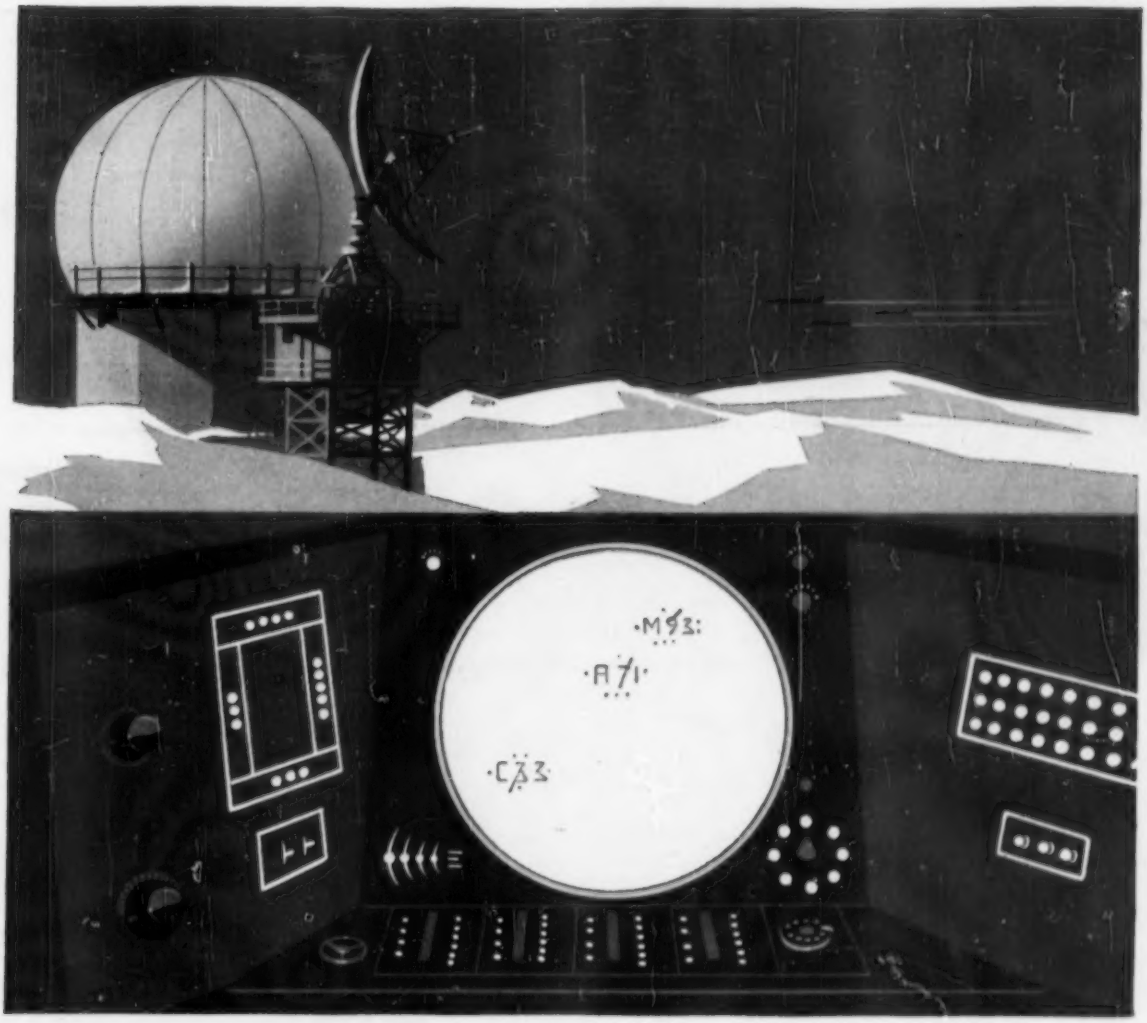

From radar antennas to "readout" equipment...

AMF has experience you can use

• Giant search antennas made by AMF form a vital part of the nation's air surveillance network • And converting the incoming radar signals into instantly understandable information are brain-like AMF Electronic Data Display Systems. The ultimate in "readout" equipment, these compact console units accept either analog or digital information, instantly convert, coordinate, and display the data on the face of a cathode-ray tube. Incoming signals can be interleaved with synthetic symbols for immediate reference, and any segment of the display can be offset and enlarged whenever desired. • See for yourself why, for radar control of air, ground, and harbors, or for general-purpose computer reading, AMF has the experience and equipment you can use.

- *Armament*
- *Ballistics*
- *Radar Antennas*
- *Guided Missile Support Equipment*
- *Auxiliary Power Supplies*
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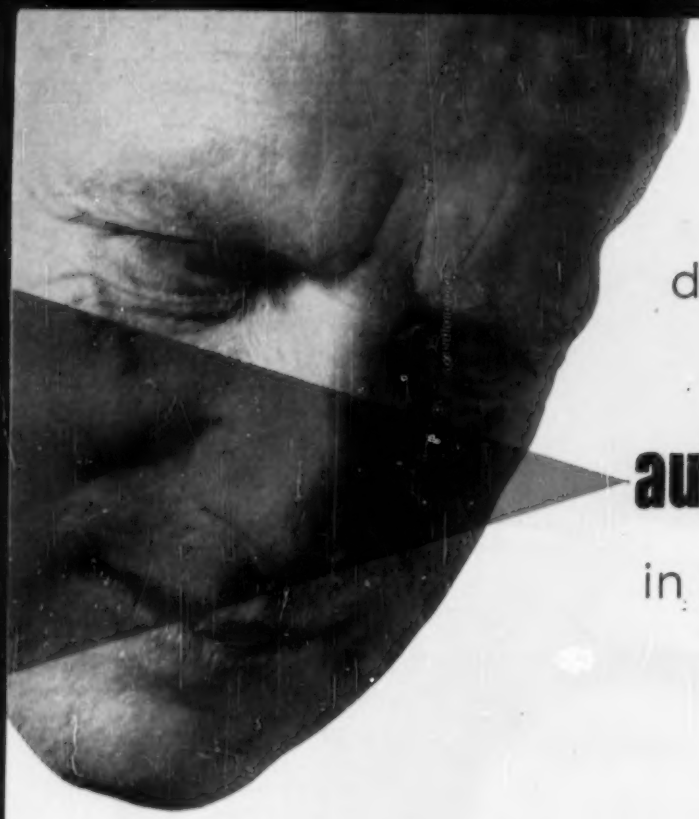
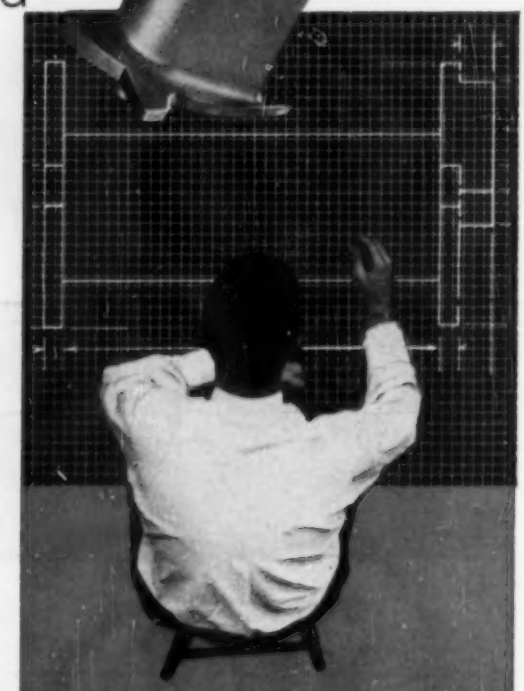


design
with
austenal
in mind



microcast *quality control starts with the blueprint...*

Quality Control at Austenal begins in the planning stage . . . long before any actual manufacture of parts is undertaken.

In order to achieve the finest finished product, design engineers consult first with Austenal engineers and profit from their experience and advice. Thus, you can *design directly for Microcast* and take advantage of the special features it makes possible.

During manufacture, many separate and vital Quality Control steps check production—from the initial alloy melt to critical examination for dimensional accuracy and internal structural soundness.

Quality Control works hand in hand with advanced research to improve and maintain Microcast techniques and applications. For this purpose, Austenal maintains the industry's finest, most advanced research facilities.

Think *Austenal* when you design. You'll be sure that high quality and maximum performance will be *built right from the beginning* into any product you require.

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...It's **NEW** *from Austenal*

After-burner nozzle segments, impractical and prohibitively expensive to manufacture by any other means, are produced by Austenal to exacting aircraft standards.

Write today for Austenal's latest booklet, "Design with Microcast in Mind."

FLY WEATHER-WISE

Mobil

These weather items prepared in consultation with the United States Weather Bureau

WEATHER AND RADIO

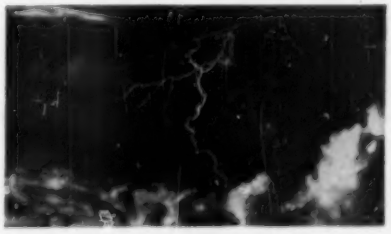
HOW WEATHER CONDITIONS AFFECT THE PROPAGATION OF RADIO WAVES

RADIO RECEPTION may vary from poor to exceptional, depending on the temperature stratification. Temperature inversions alter refraction characteristics of the atmosphere. This can result in freak reception over great distances on VHF channels.

Precipitation static—ice crystals, snow flakes and rain droplets striking aircraft can cause crackling in headphones.

Static due to lightning discharges. These occasional bursts and crashes can be picked up at considerable distance. It is often your first indication of thunderstorm activity.

How to minimize static: Change altitude if it can be done safely. Decrease speed in rain or snow storms. Where possible, avoid dry snow and cirrus clouds composed of ice crystals. Keep radio volume turned low to reduce background noise. It is preferable to use a higher frequency broadcast station for ADF homing instead of low frequency range station. During periods of static, push headphones over temples when not listening—to keep fatigue to minimum.



Aurora Borealis, associated with magnetic storms. These extra-terrestrial phenomena cause communication fadeouts. Tune in to Time Signal Broadcasts of National Bureau of Standards (5 or 10,000 kilocycles for forecasts of periods of poor reception).

NEW MOBILGREASE AERO LO-TEMP

For improved performance, added protection and reduced maintenance of grease lubricated parts—*including instruments, where protection from corrosion and minimum frictional drag are particularly important*—specify Mobilgrease Aero Lo-Temp.

For Top Flight Performance—Make it Mobil *Leader in Lubrication for 91 years*

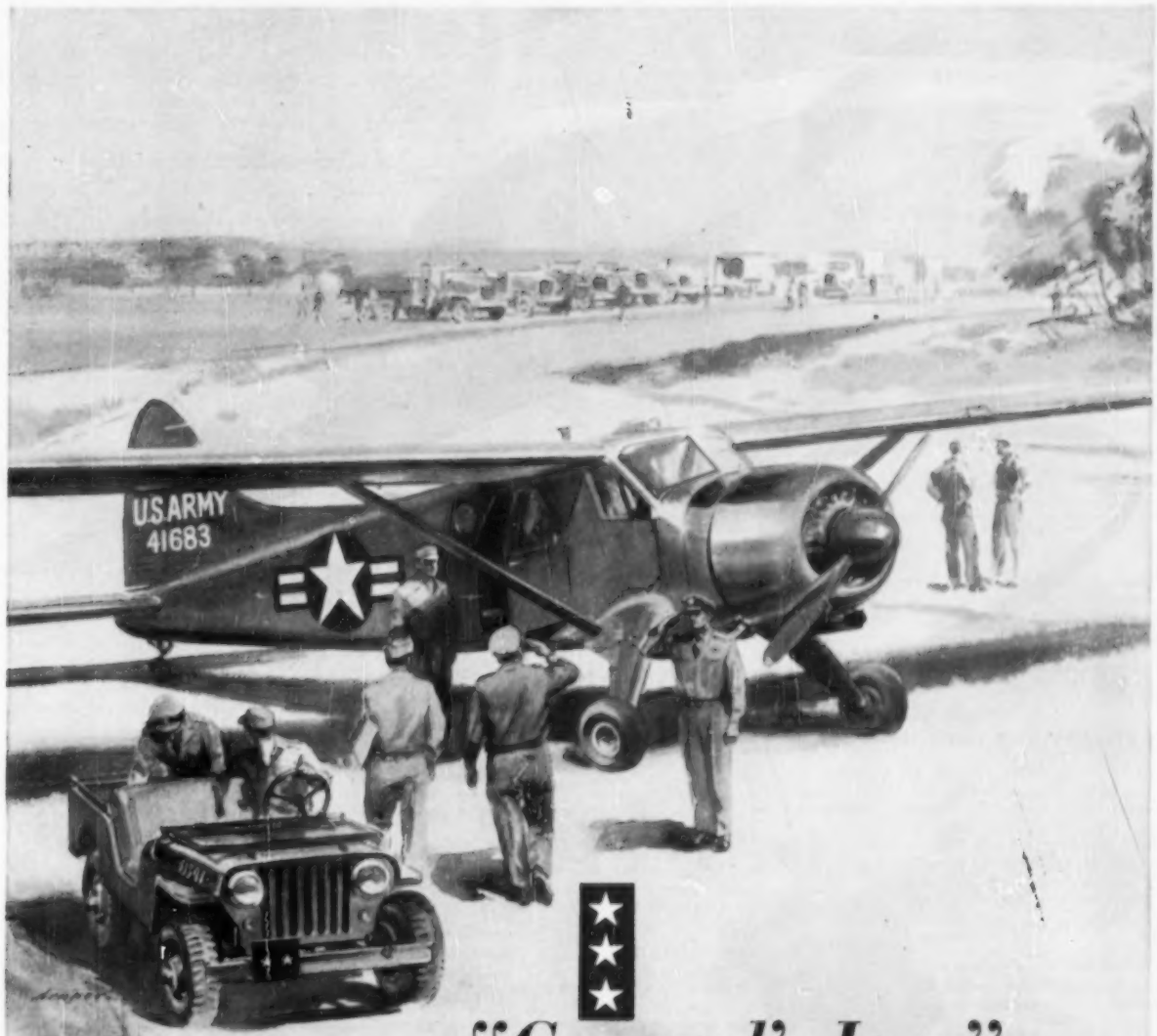
SOCONY MOBIL OIL COMPANY, INC., and Affiliates: MAGNOLIA PETROLEUM CO. GENERAL PETROLEUM CORP., MOBIL OVERSEAS OIL CO., INC.

write for sample installed on YOUR wire!

Inspect a SEALINK sample installed on *your* wire...only then will you grasp the significance of this newest of Burndy developments for wiring! Here is the very first fully water-sealed splice exceeding all immersion, dielectric, voltage drop and tensile strength requirements...a splice that keeps out the elements. Rapid, controlled SEALINK installations are made with the Burndy MR8 Hand Hytool without need for reversing the tool. SEALINKS are made for AWG conductor sizes 26 thru 10. Send us a sample of your wire—we'll send you an installed SEALINK plus full details on this new method for making insulated, sealed splices.

BURNDY

NORWALK, CONNECT.



"General's Jeep"

The Beaver L.20 has proved ideal for the movement of high ranking Officers into forward battle areas.

With 6 passengers, or a half ton of payload, and full tanks of fuel, the Beaver is airborne in less than 600 feet. (Clears 50 foot obstacle in 1000 feet).

THE *Beaver*

Designed and built by

THE DE HAVILLAND AIRCRAFT OF CANADA LIMITED

POSTAL STATION "L" TORONTO ONTARIO

Western Sales and Service: Municipal Airport, Edmonton, Alta. Pacific Coast Sales and Service: Vancouver, B.C.

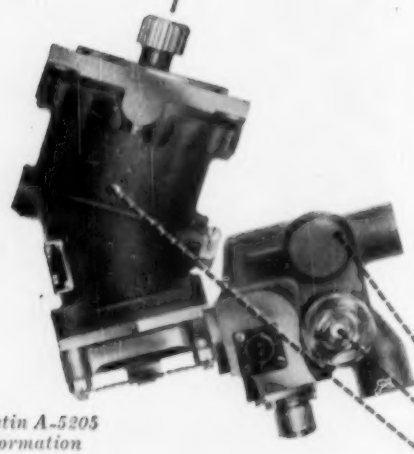
2-57

VICKERS helps scan new horizons . . .

by turning 3 tons with 13 pounds

The giant "saucer", rotating atop this Lockheed Super Constellation, contains an airborne radar antenna. It requires a high-power-to-weight ratio driving mechanism for the scanning operation. This mechanism must be compact, dependable, able to provide constant speed, regardless of load change . . . and operate in a position remote from the aircraft power supply.

The small (approximately 13 pounds) VICKERS PACKAGE DRIVE more than meets the drive requirements of the large (30 feet diameter) radome. And – like similar Vickers hydraulic components used in the Constellation for other purposes – provides proven dependability spanning many years of aircraft applications.



Drive components include:

- Modulating flow control valve maintains selected constant speed, regardless of load change.
- Slide valve for selection of motor rotation direction and speed.
- Fixed displacement hydraulic motor for driving the radome.

Write for Bulletin A-5205 for further information about the motor.

VICKERS INCORPORATED

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ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

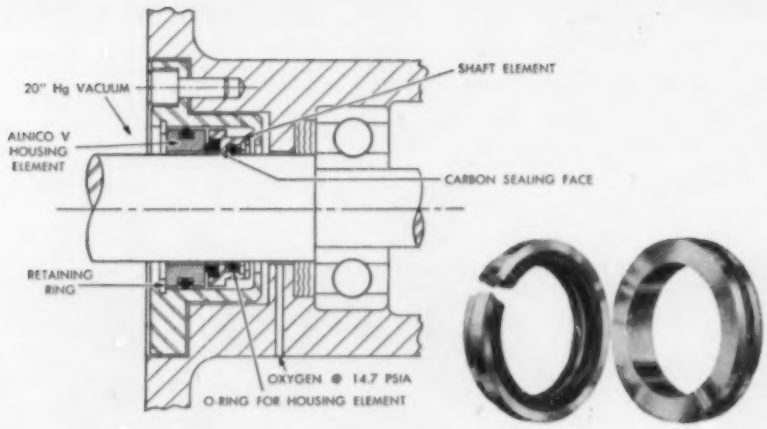


Fig. 1 — Magnetic shaft seal isolates pure oxygen at atmospheric pressure from 20" Hg. vacuum. Eliminates explosion hazard — no lubricant is required.

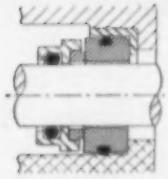


Fig. 3 – LOW PRESSURE MAGNETIC SEAL

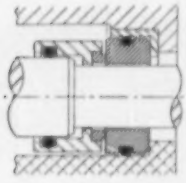


Fig. 4 – HIGH PRESSURE MAGNETIC SEAL

Effective Sealing of Oxygen Against Vacuum Accomplished by Magnetics

Gas leakage eliminated, despite extreme pressure differential — 20" Hg to 14.7 psia.

by **E. A. Steeves**

Isolating gas at atmospheric pressure from a high vacuum is a problem which puts a shaft seal to ultimate test. It calls for the highest degree of reliability over long operating periods.

Similar, though usually less critical problems arise in handling gases of all kinds. The small, penetrative molecular structure of all gases render most types of seals ineffective after very short operating periods.

By applying magnetics to this problem, designers have come up with an effective solution *(Fig. 1)*. Magnetic attraction between shaft element and housing element, evenly distributed around the circumference, provides even sealing force, immediate effective sealing, and prolonged life as the seal "wears in".

Operating Principle (Fig. 2)

A magnetized ring of Alnico V, with an O-ring gasket on its outer surface, is inserted in the housing. Another ring is mounted on the shaft and held firmly against the Alnico element by magnetic force. A carbon ring in the face of the shaft element contacts the lapped surface of the magnet and forms a permanent, self-adjusting face seal.

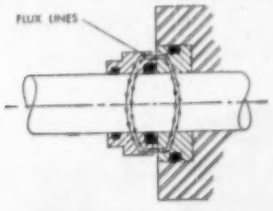


Fig. 2 — Operating principle.

An O-ring mounted inside the shaft element prevents the confined fluid or gas from escaping along the shaft. The O-ring on the magnetic element keeps the fluid from leaking out the housing.

Standard Magnetic Seals Available

Standard magnetic shaft seals are available to seal liquids or gases at high or low pressure differentials across the seal. Shaft diameters up to 2½" can be accommodated by low pressure model #10 *(Fig. 3)* and high pressure model #20 *(Fig. 4)*. There is also a standard model, number 30, for shafts over 2½".

Advantages of Magnetic Shaft Seals

Reliable, effective sealing is characteristic of the magnetic shaft seal. One of the elements of the seal is permanent magnet, so the sealing force is "built-in". No springs or screws are required . . . the sealing force is evenly distributed over the faces of the seal. There's no face leakage initially, and the seal "wears in" over its entire life . . . in many cases longer than the life of the shaft.

It is more compact in design and lighter in weight than any conventional seal.

The carbon sealing face is self-lubricating — runs cool and wears slowly.

Typical Application of Magnetic Shaft Seal (Fig. 1)

Leiman Bros., Inc., of Newark, N.J., manufacturers of air pumps, were requested to build a pump with pure oxygen at atmospheric pressure on one side and 20" Hg vacuum on the other side. The shaft sealing problem called for dry contact between shaft, seal and housing owing to the possibility of explosion that use of a lubricant would present.

No conventional seal could be found that would function in this critical application without leakage.

However, a magnetic seal was designed that proved to be the ideal solution. It formed a reliable seal for 500-hour operating periods. There was no need for lubricant since the carbon face is self-lubricating. The successful design also embodied a cartridge so that the seal could be applied to pumps that were already in use in the field.

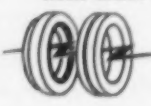
Magnetic Shaft Seal Specification

	Outside	Inside
Fluid or Gas		Oxygen
Pressure (max.)	20" Hg. Vac.	14.7 psia
Temp °F (max.)	250	
Shaft Dia. (in.)	1	
Material	Steel-SAE 4140	

Additional Technical Information is Available.

Send for complete brochure on magnetic shaft seal.

magnetic seal corp.



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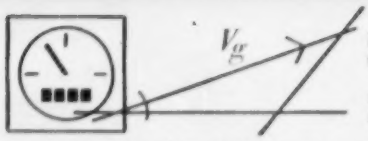


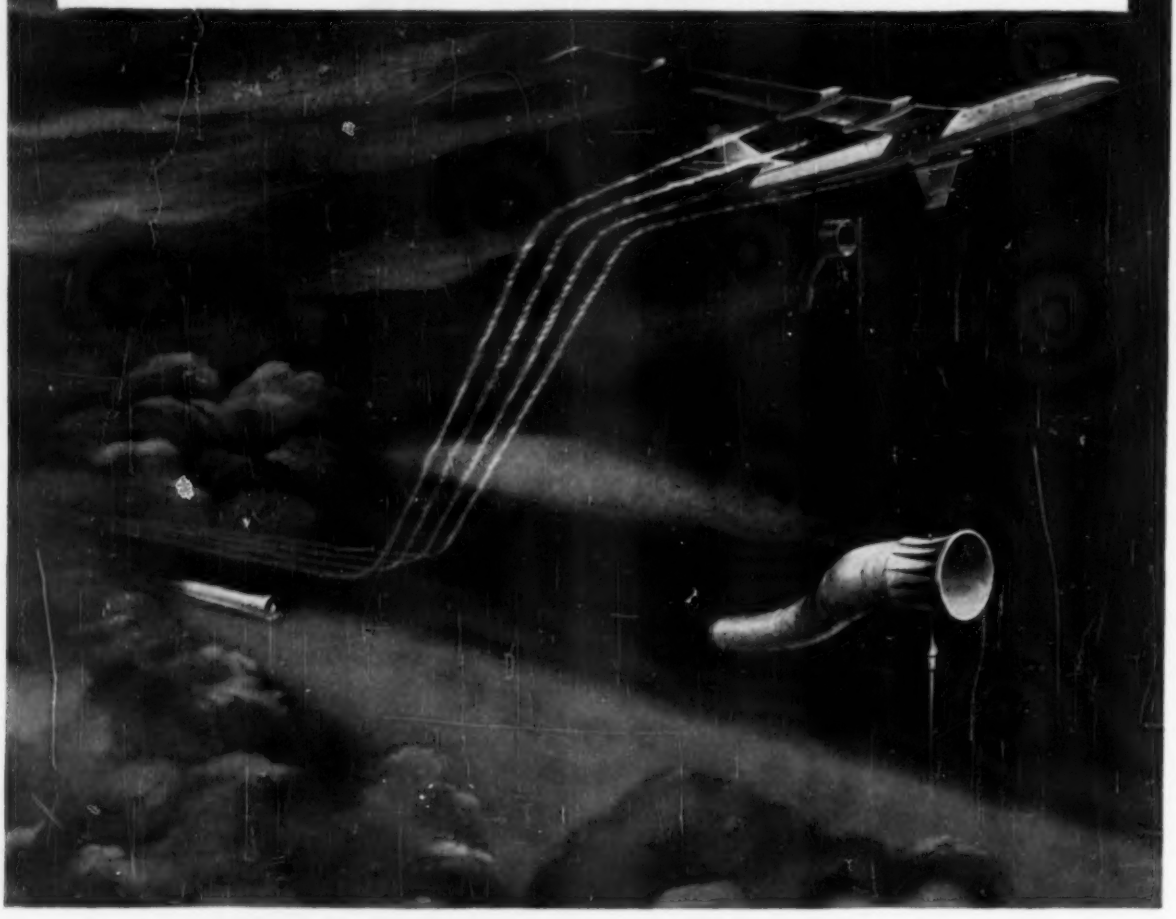
Ground Speed & Drift Angle Any Time, Anywhere, Any Weather

One look and the pilot KNOWS. In a glance he reads actual ground speed and drift angle.

This vital data, never before available, is displayed on the flight panel automatically and continuously.

The dials "read" the key unit in GPL's revolutionary Doppler auto-navigation systems. Other phenomenal units in these systems tell where you are and how to get where you're going. The systems operate entirely without ground aid or celestial fixes, have proved themselves globally in millions of operational miles.

GPL's auto-navigators were developed in conjunction with the Air Force (WADC). They are the result of GPL's harnessing of the Doppler-effect to air navigation – an achievement comparable in magnitude to the breaking of the sound barrier.



"oops! headwinds"

Spotting a headwind is easier than reading a windsock for military pilots these days.

GPL's Doppler auto-navigation systems tell them "Headwind" – and how much – the instant one appears, let them seek a more favorable wind.

Because they do, they save precious time and fuel – *and provide a priceless margin of safety.*

GPL Doppler auto-navigators are bringing about a revolution in flight. Their benefits will one day soon extend to everyone.

GPL

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SEE US AT DAYTON I.R.E. MEETING, MAY 13-15

ENGINEERS – GPL achievements have opened up some unusual research and development opportunities. Send resumé to Personnel Manager.

U. S.'s first supersonic bomber — B-58 "Hustler" built by Convair Division of General Dynamics for the U. S. Air Force. The "Hustler" is designed to carry a detachable pod and operate at altitudes over 50,000 feet.

Gives supersonic flight seven league boots

"Hustler's" conical camber and efficient turbojet help it stay supersonic for long range operations

Two things account for the "Hustler's" supersonic staying power.

One is its radical new wing: a delta with conical camber that cuts subsonic drag without impeding supersonic speed.

The other is its efficient power plant: four J-79's that operate at fuel-economizing high temperatures.

To help withstand these high temperatures Incoloy "T" titanium-containing nickel-chromium alloy is used. It lines the combustion chambers.

Designers of the J-79 picked this Inco Nickel Alloy for its heat and corrosion resistance, strength, ductility and other good physicals.

Inco Nickel Alloys are widely used in advanced aircraft

The list below shows where Inco Nickel Alloys are being used today in aircraft. If you'd like more information on their uses . . . or help in their application, get in touch with Inco's Mechanical Engineering Section.

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Where Inco Nickel Alloys are used in jet aircraft

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Combustion liners
Transition sections
Insulating blankets
Lock wire and rivets
Fuel line tubing

Inconel "X"
Rotor discs
Afterburner bellows
High-temperature bolts
Rocket engine rotors

Nimonic Alloys
Combustion liners
Transition sections
Vaporizer tubes
Turbine blades
Rotor discs

Inconel "W"
Tail cones
Afterburners

Inconel "700"
Turbine blades

Incoloy "T"
Transition sections
Combustion liners

Incoloy "901"
Turbine discs

Monel
Lock wire
Fine fuel line tubing
Rivets

"S" Monel
Ball bearing retainer rings

Pure Nickel for electrical and electronic gear. Primary Nickel as alloying element in other materials. Inco Precision Castings in many different alloys.

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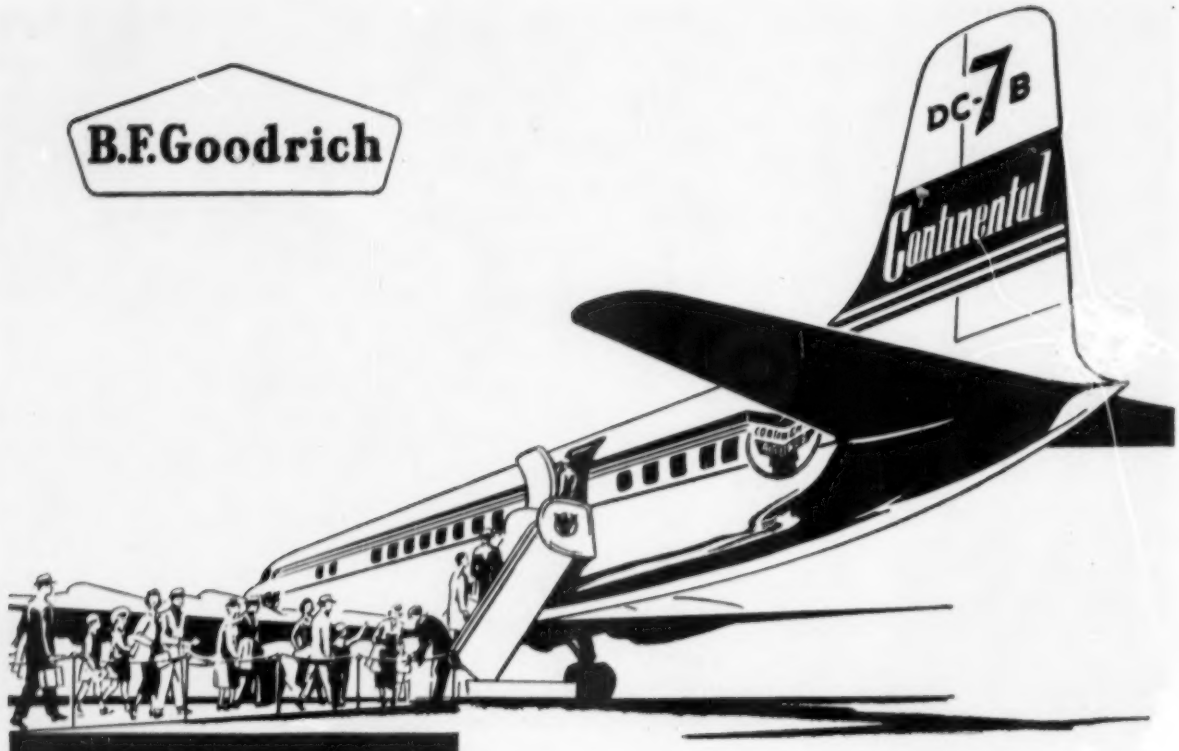

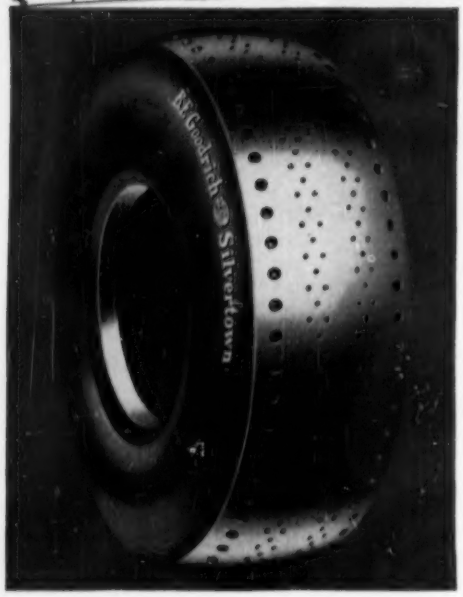

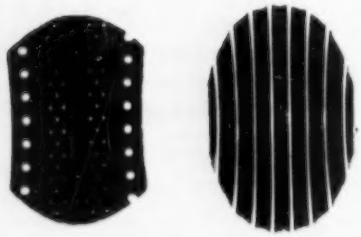

Compact, rectangular tread pattern of BFG Dimpled Tire (above left) gives average of 10% more landings than ribbed design of same size.

Dimpled tread gives 10% more landings than ordinary ribbed tread

B. F. Goodrich Dimpled Tires have been selected by Continental Air Lines for their DC-7B's flying new routes between Chicago, Denver and Los Angeles. These tires are designed to put more tread rubber to work, to spread the load more evenly from shoulder to shoulder. An over-all improvement in tread profile takes some of the load off the crown of the tire, where wear is ordinarily most severe, and distributes that weight more evenly over a broad compact footprint (see lower left).

The cup-like indentations also contribute to the extra wear of B.F.Goodrich Dimpled Tires. Because the rubber around these dimples is compressed under load, the tread is more stable and resists cutting. The result is more payload trips before tires have to be removed —landings at lower cost.

The first high-pressure Tubeless Tire, first Tubeless to land at 300 mph, and now the Dimpled Tire—all represent continuing leadership of B.F.Goodrich Aviation Products. Whether you are interested in luxury fleets, business planes or military jet aircraft, B. F. Goodrich has a complete line of tires to meet every requirement.

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MAY 6, 1957

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COVER: Modified Boeing B-47 test bed for Orenda Iroquois engine has gear down preparing to land at Malton Airport, Toronto, after its first flight. Airplane was modified at Canadair, Ltd., Montreal, and was flown from there to Malton where Orenda is installing instrumentation in bomb bay and other parts of the airplane, and the engine itself in the pod assembly attached by a pylon to the fuselage. On the delivery flight, a mockup engine identical in size, shape and weight to real engine was carried in pod (see page 39).

Picture Credits:
50, 51—Howard Levy.

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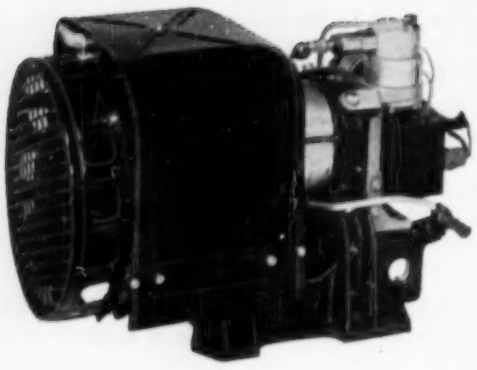
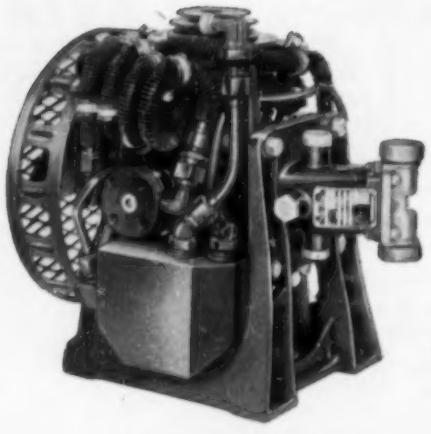
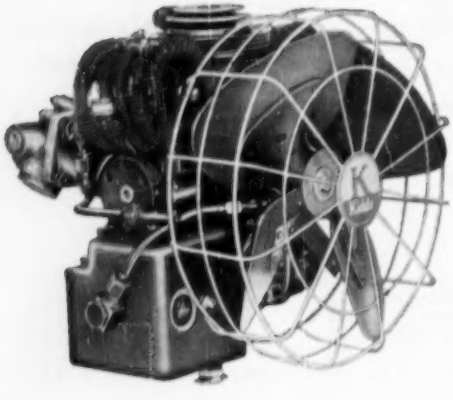


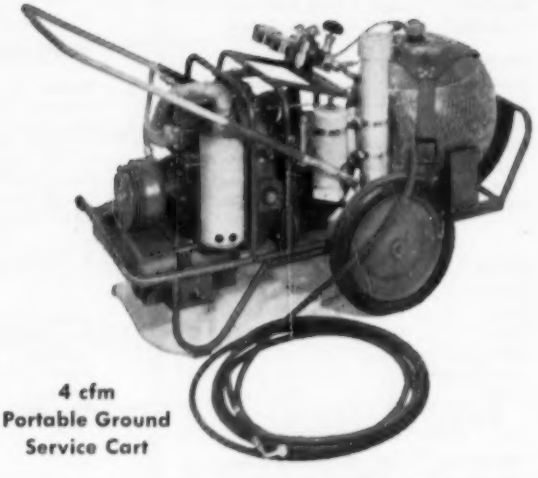
2 cfm Compressor Package



4 cfm Compressor



6 and 8 cfm Compressors



4 cfm
Portable Ground
Service Cart

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A leader in the development of dependable, lightweight pneumatic devices, Walter Kidde & Company, Inc., has in production rugged, tested 2, 4, 6 and 8 cfm air compressors. Delivering air at 3,000 and 5,000 psi, Kidde compressors may be driven by air turbine, hydraulic or electric motor, gear box or direct engine pad. Equally available are compact package assemblies providing all essential components for optimum operation of pneumatic systems. Users of Kidde air compressors include Boeing, Fairchild, Lockheed, North American, Republic, Douglas, Convair, Avro.

Also in production is the compact, portable 4 cfm ground service cart (above, lower right) which supplies dry air (stored in shatterproof, wirewound steel sphere) from 50 to 3,000 psi. Kidde has ground service carts and compressors with higher outlet pressures, larger capacities and various type drives which can be made to meet your exact specifications. For full information, write to Kidde today.

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William H. Francis, Jr., Assistant Secretary of Defense (Manpower, Personnel and Reserve), Department of Defense, Washington, D. C.

Honors and Elections

Leston Faneuf, president of Bell Aircraft Corp., and **William G. Laffer**, president of Clevite Corp., have been elected board members of the National Industrial Conference Board, New York, N. Y.

Dan B. Dyer, Deputy Chief & Senior Staff Analyst, Directorate of Intelligence, USAF, has been named a recipient of The National Civil Service League's Third Annual Career Service Awards. Each Award winner typifies . . . "dedication, talent and ability to be found in the Federal career service."

Rear Adm. J. S. Russell, USN, Chief of the Navy's Bureau of Aeronautics, has been named Honorary Chairman of the National Naval Aviation meeting (San Diego, Calif.). The sessions (Aug. 5-10) are being sponsored by the Institute of the Aeronautical Sciences and the IAS San Diego Section.

INDUSTRY OBSERVER

► A third North American G-26 ramjet-powered test missile, intermediate vehicle between the turbojet-powered X-10 and the Navaho intercontinental missile, has aborted in a test attempt from Air Force Missile Test Center, Patrick AFB, Fla. Vehicle was lost in attempted takeoff when a rocket booster blew up. Previously, another G-26 went out of control when the roll gyro malfunctioned. Still another loss resulted when the booster refused to separate from the missile and the ramjet engine failed to light. G-26 booster is not the same as the three-barrelled 405,000 lb. thrust booster that will be used on the production version of the Navaho.

► **Allison Division of General Motors is working on two new engines—the J89, a very large dual spool turbojet with about twice the thrust of the 10,000 lb. Allison J71, and a two-spool turboprop with substantially greater output than the 3,750 eshp. Allison T56.**

► Army-Marine Corps competition for a high-altitude observation plane has been narrowed to two manufacturers—North American Aviation-Columbus and Grumman. Eight competitors were originally in the field. North American's entry is a twin boom, high-wing, two-place aircraft powered by twin General Electric T58 engines.

► **Takeoff of Convair F-106A, now being flight tested at Edwards AFB, Calif., is made without afterburner because of the power of Pratt & Whitney's J75—approximately 15,000 lb. Afterburner takeoff develops speed so rapidly that trouble is encountered in retracting the landing gear in time to keep the wheel well doors from being ripped off.**

► Photoelectric type infrared detector, capable of operating at wavelengths out to six microns compared to previous one and one-half micron limit and which requires no cooling provisions, has been developed by Texas Instruments Inc. Device exceeds performance characteristics which Russians and British have released on similar devices: time constant of two microseconds; noise equivalent power of 0.0007 microwatts.

► **Deck motion probability predictor has been tested by Cornell Aeronautical Laboratory as part of an all-weather carrier landing system developed under the Navy's Project Peco. Deck motion is predicted a few seconds ahead with a probability of 75%.**

► Navy's all-weather carrier landing system has created a requirement for a wave-off computer. Its task is to reintegrate a wave-off aircraft back into the navigation and traffic pattern.

► **Engine placement on North American Aviation's A3J jet-powered attack bomber is in the tail, with side-by-side jet exhausts protruding from the fuselage tail.**

► Bendix is looking for a low-cost fin for its Talos surface-to-air missile. Best bet at present appears to be Fibreglas fin which one manufacturer believes he can make at a fraction of the cost of fins made of other materials. Bendix already has rejected proposals for a magnesium fin.

► **Snecma has pilot-flown P2 Flying Atar vertical takeoff jet testbed. Pilot is installed in tip-up cockpit fitted above the jet engine air intake. Previous to piloted flight, unit made several remote controlled flights. The rig will later be equipped with an annular wing (AW Dec. 24, p. 23).**

► Lightweight constant-speed drive is under development by Hamilton-Standard. New drive operates on a mechanical principle originally patented in Switzerland and later used by New Departure in its Transi-Torque automatic transmission. Transi-Torque, believed by many to be the best type of transmission available, was passed over for automotive use because of the large quantity of high-grade steel it required. Hamilton-Standard's aircraft application will allow an exceptional weight saving over currently available constant-speed drives.

Dr. Lloyd P. Smith

President, Avco Research and Advanced Development Division

speaks out about AVCO . . .

AND THE RACE AMERICA MUST NOT LOSE

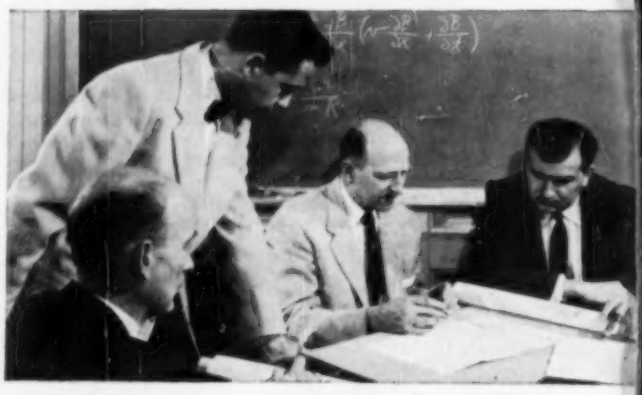
Our greatest aim is to make truly significant scientific discoveries and technical developments. Discoveries which add to our scientific knowledge. Discoveries and developments which lead to new products which can be produced for the good of mankind and insure our continued economic prosperity. Discoveries and developments which will maintain the nation's defenses strong. Most of all, to make discoveries and technical "breakthroughs" which will give our country the scientific and technical leadership and prestige which are so essential for maintaining the peace of the world. We fully realize that to attain these objectives we must win out in a great scientific game against a competent and ambitious adversary.

The Avco Research and Advanced Development Division, with its team of creative scientists and engineers, is expending great effort to reach these goals. Significant accomplishments have already been made in the physics, chemistry and gas dynamics associated with the high-altitude, hypersonic flight of missiles; the intercontinental ballistic missile re-entrance problem; missile stability; and electronics as applied to advanced radar, computers and air navigation.

New fields are under investigation and the division hopes to make technical "breakthroughs" in magnetohydrodynamics, controlled thermonuclear fusion, conversion of chemical and nuclear energy into useful work, the creation of new materials, the manned satellite, and many other areas. Some of these fields are so new that our laboratories must also be teaching centers so that young scientists and engineers who join us can learn the science and technology basic to these new fields while contributing their own creative investigations.

Lloyd P. Smith

Dr. Lloyd P. Smith



A new idea is nourished by exposure to men representing many different scientific specialities—a characteristic operating method at Avco Research and Advanced Development Division.

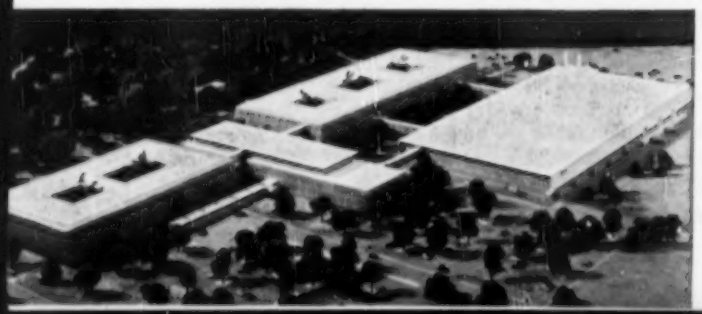
Avco's new research division is now offering unusual and exciting career opportunities for exceptionally qualified and forward-looking scientists and engineers in such fields as:

SCIENCE: Aerodynamics · Electronics · Mathematics · Metallurgy Physical Chemistry · Physics · Thermodynamics

ENGINEERING: Aeronautical · Applied Mechanics · Chemical · Electrical Heat Transfer · Mechanical · Reliability · Flight Test

Write to Dr. R. W. Johnston, Scientific and Technical Relations, Avco Research and Advanced Development Division, 20 South Union Street, Lawrence, Massachusetts.

Pictured below is our new Research Center now under construction in Wilmington, Massachusetts. Scheduled for completion in early 1958, this ultra-modern laboratory will house the scientific and technical staff of the Avco Research and Advanced Development Division.



avco | **research and advanced development division**

Washington Roundup

Cordiner Battle

Watch for major controversy over fate of the Cordiner Committee recommendations to improve the status of skilled technicians in the military services.

Friends of the program are coming to a slow boil over the fact that the economy-minded administration has killed the Defense Department's initial effort to get action, arguing that the proposed legislation is "inflationary." Ralph J. Cordiner, president of General Electric, who headed the elaborate manpower study, already has said the committee's proposals can save up to $5 billion a year within five years.

The Bureau of the Budget, however, has an eye on the possibility of a tax cut long before 1962. The Air Force Assn. already has opened fire, pointing out that the rejected legislation would not increase the Fiscal 1958 defense budget. Cordiner himself has maintained silence but may resort to sharp disagreement with officials at cabinet level.

Jupiter Abort

Discount reports that Defense Secretary Charles E. Wilson saw a successful firing of the Army Jupiter intermediate range ballistic missile during his recent visit to Patrick AFB, Fla. Despite early accounts that the weapon went approximately 600 miles, authoritative sources say it was destroyed in the air at the end of its vertical climb and before it really entered the trajectory. Race between Jupiter and USAF's Thor for first fully successful firing will continue.

MATS Traffic Fight

Look for active participation by six local service airlines in the current push by scheduled and non-scheduled airlines before several congressional committees to attain greater diversion of military traffic from Military Air Transport Service to civil carriers.

Joseph Adams, former Civil Aeronautics Board member and interim director of the newly formed Assn. of Local and Territorial Airlines, has earmarked this program as a "most worthwhile field of activity for ALTA."

Adams claims presentations on Capitol Hill to date have failed to include local service carriers, and he has placed the MATS item high on the agenda list of the association's meeting in Washington tomorrow. It will be the first formal session of the group since its organization when six local service carriers broke with the Conference of Local Service Airlines on "policy matters" (AW Feb. 18, p. 35).

Adams also will ask the association to formulate a policy for general route improvement and for the removal of restrictions that limit the potential development of the local service carriers. Other items on the agenda include: guaranteed loan legislation, Capital Gains Bill, CAB rate of return investigation and the general passenger fare investigation.

CAB Complaint

Civil Aeronautics Board has begun enforcement proceedings against two airlines charged with deliberately overselling flights to offset no-show passengers.

Petitions of enforcement were filed by the CAB compliance section against Eastern Air Lines and Delta Air Lines. At least one more company is expected to be named as an alleged violator.

In the complaints against the two, the CAB said both Delta and Eastern have refunded part or all of the amount of the ticket to persons who held space previously committed, permitted them to retain their tickets for transportation on later flights.

Senators Criticize Cutback

The powerful Senate Preparedness Subcommittee headed by Senate Majority Leader Lyndon Johnson (D.-Tex.) is protesting Army's plans to cut back on procurement of conventional ammunition and weapons as part of its modernization program.

The subcommittee has directed that "a thorough review of the program for the production of conventional ammunition be instituted immediately by the Secretary of Defense. This study should determine whether the present conventional ammunition program is consistent with and in fulfillment of the designated missions of the services and whether budgetary considerations have not, in fact, reduced the ability to carry out these missions."

Eastern Lease

Civil Aeronautics Board has granted Eastern Air Lines an exemption from a hearing and permitted the company to lease seven DC-6s from Twentieth Century Aircraft Co.

Twentieth Century is a member of the Trans-American combine that was ordered to cease operations by the CAB for violations of the Civil Aeronautics Act. Under terms of the agreement the first aircraft was to be delivered to Eastern last week; four others will be delivered by June 30; the final two in April and May, 1958.

Quarles, Douglas Sworn In

Donald A. Quarles was sworn in by President Eisenhower last week as Deputy Defense Secretary, replacing the retired Reuben Robertson, Jr. (AW April 1, p. 30). At the same time, Eisenhower swore in James H. Douglas to replace Quarles as Air Force Secretary. Douglas was stepped up from his former post of Under Secretary of the Air Force.

Hope for Science

Elevation of Donald A. Quarles from Secretary of the Air Force to Assistant Secretary of Defense has raised hopes of some scientific partisans that the cool attitude of the Pentagon toward basic research will be tempered in the near future. Quarles has many friends who retain faith in his professional integrity and they recall his firm stand in early disagreements with Frank D. Newbury, who had frowned on basic research, when he was Assistant Secretary of Defense for Research and Development.

These men are confident that the recent USAF chief will take a fresh stand if he succeeds Defense Secretary Charles E. Wilson later this year, as rumored in some quarters. "Quarles," said one observer, "used to be interested in why the grass is green. I have an idea he still is."

—Washington staff

X-15 Capability Outstrips Speculation

Research rocket craft's design is practical, safe; Scott Crossfield describes his part in X-15's conception.

By Irving Stone

Los Angeles—Capabilities of North American Aviation's rocket powered X-15, extreme-speed-and-altitude piloted research aircraft design, are far greater than the industry imagines, AVIATION WEEK has learned.

Despite the big jump the aircraft will represent in aeronautical achievement, the design, no "wild blue yonder" conception, is being accomplished within boundaries of todays engineering practicalities, emphasizing a high degree of pilot safety.

Confirming a long-held industry belief, NAA has announced that Scott Crossfield, who joined the company in 1955 after serving five years as engineering test pilot for National Advisory Committee for Aeronautics, will pilot the X-15 when it makes its first flight, scheduled for next year. At this time no one else has been picked to fly the plane, but NAA's engineering test pilot A. W. (Al) Blackburn will backstop for Crossfield in the flight phase.

Part in Concept

In an interview here, Crossfield revealed that while with NACA he had some part in the original conception of the X-15, a medium-size flying research laboratory designed to provide confirmation in the area between theory and development in very high speed and altitude flight. Crossfield also participated in the evaluation of competitive bids for the X-15 contract, and joined NAA as engineering design specialist and experimental pilot after the company won the X-15 competition.

"This is one of the few occasions when a man who is going to fly a plane is having a chance to have some influence in its design," Crossfield declared, referring to the X-15. Important features of the aircraft undoubtedly will reflect Crossfield's ideas, as a logical extension of the state of the art represented by previous research aircraft. Trend is growing toward greater participation of engineer-test pilots in aircraft design.

An aeronautical engineer, Crossfield has done flight research and experimental testing on such aircraft as X-1, X-4, X-5, XF-92, D558-I, D558-II, F-86 and F-100.

Demonstration of the plane for NAA by Crossfield will be at a limited speed figure, which may be fairly low, Crossfield declared. Military and NACA pilots will take it farther into the speed regime towards its top capabilities, for feedback of information to industry. The X-15 is being built by NAA for NACA under military contract. NAA has scientific, technical design cognizance of the plane.

No details of the X-15's performance or makeup have been officially confirmed, but AVIATION WEEK has previously revealed that the plane's speed capability will be in the region of Mach 6 to 7 (AW April 29, p. 26). Altitude figure has generally been placed as over 100 mi. One of the reasons for going to extreme altitude is to achieve very high speed.

Structure probably will embody relatively thin-gage high-heat-resistant material such as Inconel-X or other high-heat super-alloys now available, AVIATION WEEK has learned.

Crossfield would not comment on what specific measures were being taken to cope with the heat generated, which might be in the region encompassing 1,500 to 2,500F, he declared. Acknowledging that heating would pose a severe problem, he indicated that a solution for the pilot was available when he added that "cockpit heat would depend on insulation and cooling and there is no reason to expect that the cockpit couldn't be designed as comfortable as it is here," referring to the normal temperature of the room where the interview was being held.

Cockpit Light

Cockpit also will be artificially lighted, Crossfield said. This will be necessary because at very high altitude there is comparatively little diffusion of light and there is distinct difference between sunlight and shadows.

Emergency escape provisions have been determined by a thorough analysis of accident possibilities. At extreme altitude there would be little danger of the plane failing structurally. Fire or explosion at this high altitude would also be a small hazard, Crossfield said, indicating that powered flight would be confined to lower altitudes.

Stressing the point that safety, like other design factors, must be a compromise or else the "plane can become one big escape system and no plane," Crossfield declared that nevertheless "there are better emergency provisions in this plane than any previous rocket engine plane insofar as escape provisions are concerned."

He would not reveal escape system details or confirm AVIATION WEEK's previous prediction that no escape capsule would be employed, but declared that special personal pilot-equipment is ten years ahead compared with present high altitude equipment. Incorporating some of Crossfield's ideas, this equipment is being provided by the Air Force through the aeromedical laboratory at Wright-Patterson AFB.

Analysis has shown that estimate of chance of pilot survival is 92% if a dire emergency develops, Crossfield revealed. With no dire emergency, there is 100% chance of survival—better than in present planes, he said.

Major load in the X-15 will be fuel because of the operational requirements and rocket engine appetite. People close to the design refer to it as a "flying fuel tank," but to carry out its prime role as a research craft, the X-15 also will tote a very heavy payload of instrumentation for complete coverage of a new partially-powered flight regime.

The new liquid propellant rocket powerplant, which will be supplied by Reaction Motors, Inc., will afford more power than was available in the Bell X-2 rocket-powered research plane. This is a normal progression in power required because of the far stiffer requirements for the X-15. No booster will be used in conjunction with the RMI rocket engine, AVIATION WEEK has learned. This will save weight, simplify structural mounting problems.

Mockup Help

There will be very extensive simulation of X-15 characteristics before actual flight. Investigation has been conducted on Navy's Johnsville, Pa. centrifuge to simulate violent maneuver which may occur.

Mockup of the plane also constitutes a tremendous help, Crossfield said, to improve original design ideas, and factors relating to weight, size and distribution of components, work area available to pilot. Mockup will be operational to some extent to permit "preflight feel."

There was a very good response to aeromedical aspects of the design from Randolph AFB School of Aviation Medicine scientists and military personnel who visited NAA recently and inspected X-15 mockup. "It was of tremendous interest to them to know we have gone as far as we have," Crossfield declared. No special physical training for flight will be required, he said.

As to whether any special devices would be required to prepare for control of the X-15, Crossfield said that the control system "won't be that tough a problem. . . . Job won't be a piece of cake, but it will be as reasonable an

approach as possible, developed on a step-by-step basis to insure greatest safety."

Landing the plane will determine its lift (wing) characteristics, Crossfield said.

He would not reveal if landing would be all-glide or powered in any phase, but declared "we don't contemplate any extreme change for recovery of the plane on the ground."

While fabrication of parts has begun for the X-15 (AW April 29, p. 26), a considerable portion of the plane is still in the design stage. Wind tunnel tests on the X-15 are now nearing completion.

A sizeable design force is engaged on the X-15 project under Charles Feltz, project engineer.

Sweden Studies Role Of Fighter Aircraft

Stockholm—Sweden's Saab Aircraft Co. is preparing several versions, including a two-seat trainer, of its supersonic double-delta J35 Draken (Dragon), and it has a successor to its S32 Lansen (Lance) fighter-bomber on the drawing board.

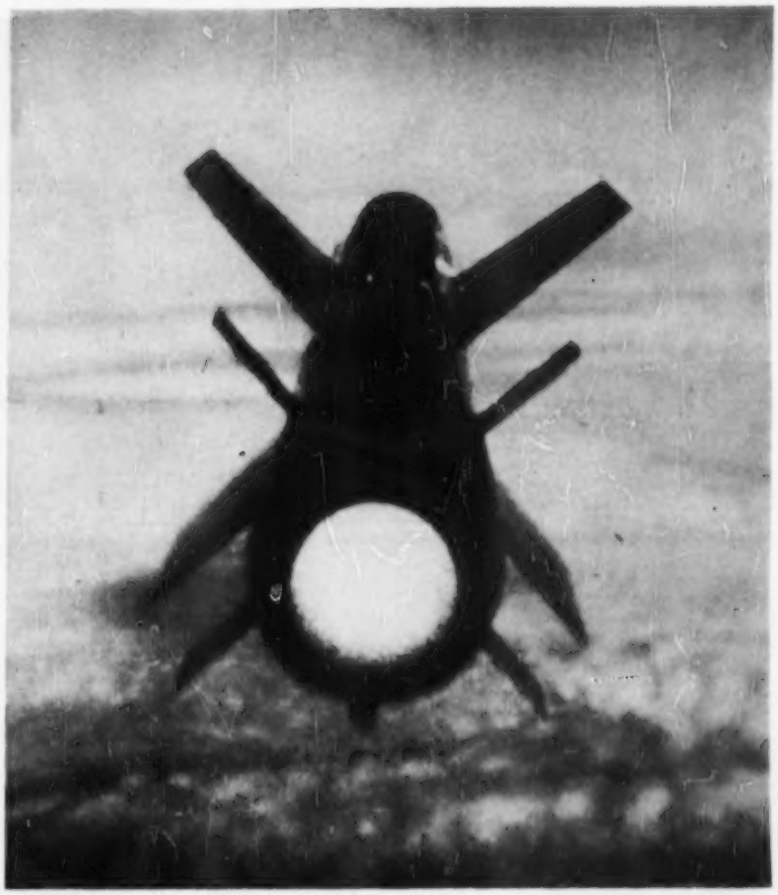
However, the J35 may be the last Swedish piloted fighter before the Swedish air force enters the guided missile age in the latter half of the 1960s, according to Maj. Gen. Lennart Peyron, Air Force chief of staff.

Sweden expects to need at least another generation of fighter pilots before ground-air missiles replace piloted aircraft, the general said. Even then, he said, piloted aircraft will be needed for low altitude missions where missiles are less effective.

Swedish navy also is looking to changing equipment needs. It wants to organize helicopter units for anti-submarine warfare. Though Vice Admiral Stig Ericson, commander in chief, stresses the need for tactical atomic weapons and missiles, he recommends waiting two or three years before guided missile destroyers or their equivalent are added to the navy because of the uncertainties of guided missile development.

Defense modernization program presented in 1954 will be revised in the light of introduction of modern weapons, and relative strengths of the services will be evaluated as to their effectiveness and the nature of a probable war.

Touching on a possible war, the air chief of staff disclosed that the air force would use Sweden's national highways as runways. Modern tricycle landing gears make landings and takeoffs on narrow strips fairly easy, Gen. Peyron said.



STERN VIEW of de Havilland infrared Firestreak indicates little similarity with Navy Sidewinder. U. S. missile has large clipped tip delta fins at tail and small delta surface near nose, appears to be longer than Firestreak.

British Missile Details Revealed As Air Estimates Are Published

London—De Havilland infrared homing air-to-air missile, which will be called Firestreak, has an infrared system of "great range and sensitivity," but Air Ministry acknowledged that it can be jammed. The disclosure came in a discussion by officials of Britain's 1957-58 air estimates.

The missile, for which a production order has been placed (AW April 29, p. 33), will be fitted to Gloster Javelins and English Electric P.1B fighters. Acceptance trials of the missile are to begin soon.

The Ministry also disclosed that the Bristol surface-to-air ramjet weapon ordered at the same time, will be called Bloodhound.

Conversion from manned fighters to missiles was subject of comment, a spokesman pointing out the change is not as drastic as it might sound.

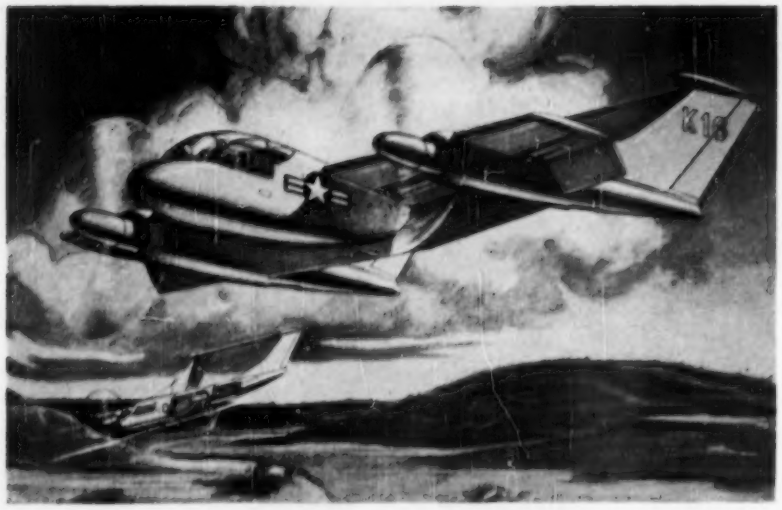
The estimates provide a total of $1,400 million for the fiscal year, a net increase of $28 million over the final 1956-57 estimate.

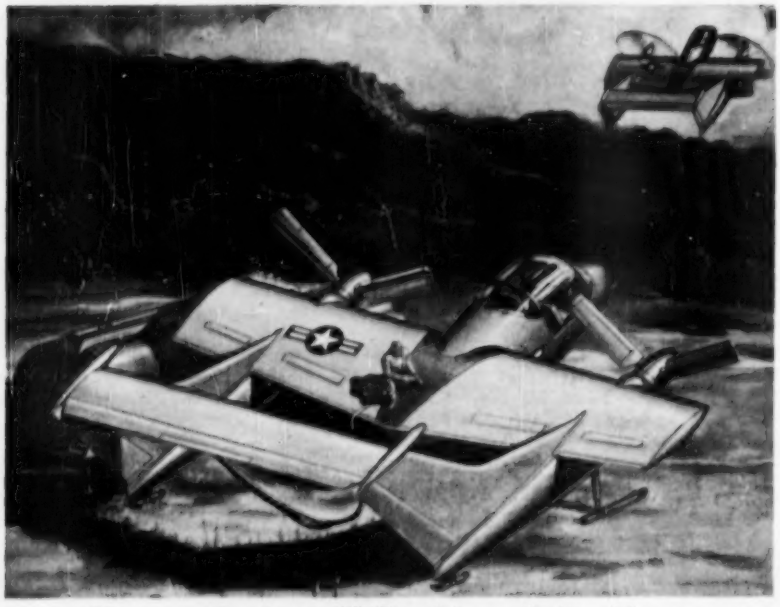
Spending on aircraft and equipment is to be about $35 million less than last year. However, reduction in American aid and other receipts requires a net provision for aircraft and equipment about $50 million higher than last year.

Memorandum from Air Minister George Ward said the V-bomber force will be built up steadily and later marks of the V-bombers will carry a guided bomb. Air Ministry sources said this air-to-surface weapon is in an advanced stage of development, but declined to name the maker.

It was also revealed that a British ballistic missile is well along. This is believed to be a weapon with a range approximating 2,000 mi. and a speed of 10,000 mph.

The air minister noted that Valiant elements in the RAF now are at full





Kaman Designs STOL Aircraft for Navy

Small controllable flaps in the trailing edges of propulsive rotors (lower) are used by Kaman Aircraft Corp. to provide cyclic and collective pitch control in STOL design developed under Navy BuAer contract. Large Fowler flaps in wing are device for additional lift during takeoffs, landings and slow-speed flight. Rotors are powered by turbine engines. Rotor flaps give pilot full control under 50 mph. Over this speed, rotor flap system automatically phases out and conventional rudder, elevator and aileron controls take over. Kaman estimates aircraft's top speed at more than 300 mph. Full scale semi-span wing with powerplant, propulsive rotor and controls for ground test of lift and control characteristics of system are being built by Kaman under the Navy contract.

strength. Vulcans also are in service and the Victor will enter service this year.

Official spokesmen emphasized that the process of replacing bombers with guided weapons will be a lengthy one and said there will be a considerable period when both are in use. This will also hold true for manned fighters and defensive missiles.

Air minister said the Fairey Fireflash, which is being used by the RAF as a training weapon, has shot down several target aircraft even when not fitted with an explosive warhead. He said full-scale service trials of this missile will begin soon.

Missile Base

RAF now is building its first anti-aircraft missile base at North Coates in Lincolnshire. It is to be ready for service trials next year. This is the first of a ring of such bases to be constructed in the United Kingdom. Presumably they first will be equipped with the Bristol Bloodhound missile and later with an English Electric weapon, which is described as more advanced. This is a joint RAF-Army weapon. No RAF production order for it has yet been placed although one is anticipated.

Spokesman for the Air Ministry said the British government had been "forced" to step up its guided weapons program by the rapid improvements in defensive systems, both missile and manned fighters.

Defense Answer

He explained he was not referring specifically to Russian developments but to defenses generally.

The spokesman also hinted at a defensive answer to the ballistic missile, which he refused to accept as the "ultimate" weapon. "There has never been an ultimate weapon yet," he said. The Air Ministry and Ministry of Supply have been studying the problem of defense against ballistic missiles.

"It is a formidable problem," the top ranking official stated, "but it does not seem insoluble. A great technical effort is needed, however, and that costs money." He declined to give further details.

The ministry spokesman said Britain's decision not to build a successor to the English Electric P.1 fighter or a supersonic bomber was made early this year by the Air Council on "military grounds."

It is not as drastic a step as it might seem, he said since "what we have done is decide not to have replacements for aircraft we do not yet have."

Deterrent Search

The official emphasized that Britain's military plans now revolve around the problem of providing a deterrent capable of "overwhelming destruction" to vital enemy areas. This is the purpose of the offensive and the purpose of the defense is to protect the deterrent strength.

"It is possible to impose such a hazardous and difficult problem on the enemy that he can never be sure of destroying the deterrent," it was stated. Key to defensive plans is to protect the V-bombers and missile bases from surprise attack.

The air to surface weapon will be brought into service well ahead of the ballistic missile, the ministry spokesman said, and will greatly improve the usefulness of the V-bomber fleet. Ultimately, it was disclosed, it may be possible to fire these rocket powered "stand off bombs" from various points beyond detection by the Russian radar network.

USAF Moves to Cut Industry Overtime

By Claude Witze

Washington—USAF and the Navy's Bureau of Aeronautics took steps last week to reduce overtime pay costs in the aircraft industry.

In a directive applying to all aircraft and component procurement with the exception of ballistic missiles, these new regulations were put in effect:

- **Military plant representatives** can authorize overtime only to 2% of the project's total man-hours. Previously, the representative was not restricted.
- **Overtime in excess of 2%** must be approved in advance by headquarters of the Air Materiel Command or BuAer.

A separate directive covering missile contractors is being prepared and probably will be promulgated this week.

It was emphasized by spokesmen for both services that the new order does not eliminate overtime where it can be justified for reasons of economy or to meet a vital schedule. A top USAF procurement officer described the directive as "a reiteration of controls" or an "admonishment with some specifics."

The action was blamed upon the rising cost of aircraft in the face of a restricted budget. Many procurement officials are convinced there are areas in which overtime is not justified and can be eliminated without causing schedule slippage.

Industry reaction was that the order was put into effect too suddenly. Contractors with production schedules based on the regular use of overtime faced the immediate necessity of revising the schedule because there was no time allowed to present a justification for the extra expense.

Neither industry nor military officials were able to estimate the amount of savings that will be realized. In the absence of figures on the amount paid for overtime in the aircraft industry, the nearest clue was that the bill usually runs to about 4% of the overall expenditures on a production program.

The limit of 2% of total manhours was expected to eliminate overtime in some areas in order to allow it to continue in others. For example, overtime may be stopped in an aircraft plant's engineering department in order to keep it available for flight test work.

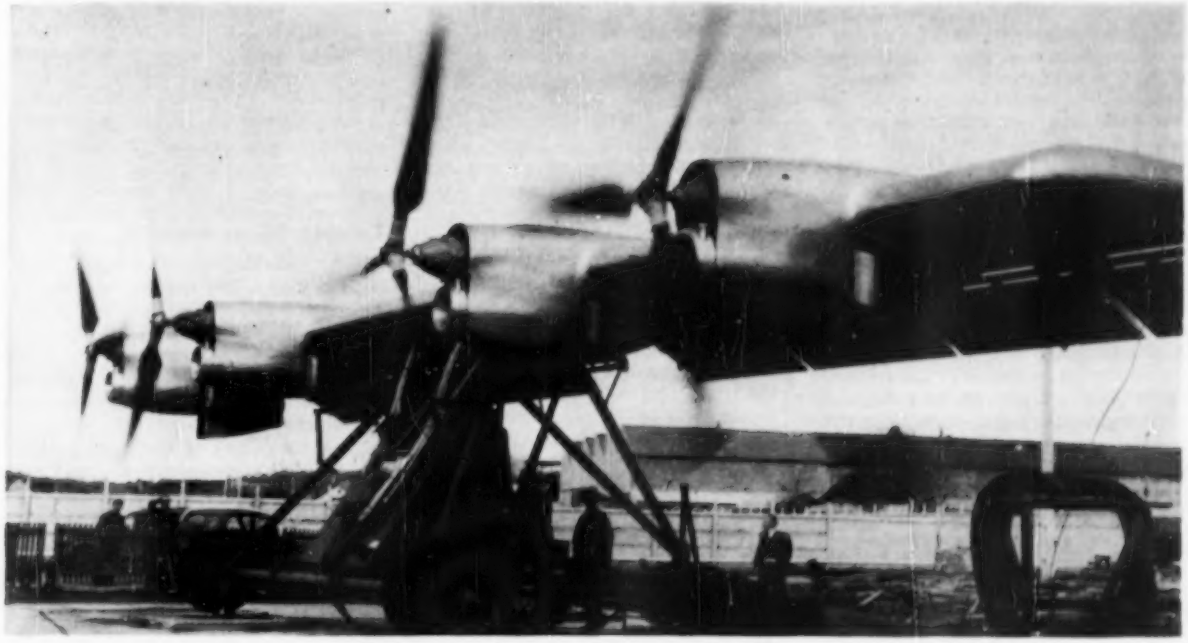
In many companies, flight test overtime is essential to keep pace with the production rate, particularly after a spell of bad weather.

There was some speculation about the effect of the order on the industry's relations with labor. In some cases, overtime pay has become a regular thing and is looked upon as part of the regular week's income. It is anticipated there may be some job shifting caused by the cut in pay.

At some plants, where overtime already has been held to a minimum under company economy policies, the new directive was viewed as unnecessary. At the same time, it was pointed out, it will force these firms to increase their paper work when extra hours must be justified.

Another problem area was anticipated if ballistic missile manufacturers are permitted to be more generous with the overtime. In addition to attracting employes from other aircraft plants, these companies may have unequal pay opportunities if they also make conventional airplanes. Engineers and assembly line workers are expected to prefer work on missile projects if the take-home pay is greater.

Small business, as well as the major prime contractors, is expected to need readjustment under the order. It was pointed out that many shops with limited facilities work a regular six-day week to obtain maximum utilization out of equipment and manpower.



Breguet Tests "Blown" Wing

Breguet's STOL wing, planned for Breguet 940 civil transport, uses no tilting wing or rotor mechanism, instead gains lift by deflecting induced airflow over wings into downward thrust by use of double slotted flaps. Entire 58 ft. wing is in wash of propellers. Four Turbomeca Turbo engines rated at 400 eshp. power the design, which at a gross weight of 14,300 lb. including a 21 passenger payload, is expected to takeoff in 200 ft. Fuselage is under construction and plane is expected to fly by the end of the year. Breguet is planning a larger version, the 941, twice the size and powered by four 1,000 eshp. turboprop engines.

Gavin Says Wilson Directive Crippling

By Katherine Johnsen

Washington—Ground rules laid down for service roles and missions by Defense Secretary Charles E. Wilson late last year will "unquestionably prevent" the Army from fulfilling its mission, according to Lt. Gen. James M. Gavin, Army chief of research and development.

In testimony before the House Appropriations Committee released last week, Gen. Gavin said the Army plans a continuing fight to break through the limitations imposed by the Wilson directive (AW Dec. 3, p. 30). He told the committee:

- **The 5,000 lb. weight limitation** on Army aircraft "will unquestionably prevent the Army from developing the aircraft necessary for fulfillment of its mission. . . . The Army must have integral aircraft capable of moving reasonable numbers of men or quantities of materiel within the combat zone. The requirements for this sort of transport are such that it cannot be economically fulfilled with fixed-wing aircraft weighing less than 5,000 lb. . . ."
- **100 mile range limit** for Army surface-to-air missiles places no limitation on Army projects at present, and "it is inferred that the limitation will be reconsidered when justified. . . ."
- **200 mile range limit** on Army surface-to-surface missiles is unrealistic. "Our concepts of future land combat envisage requirements for firepower to be delivered beyond the 200 mile missile system."

Helicopter Too Expensive

Gen. Gavin said that, unless the 5,000 lb. weight limit on aircraft is lifted, the Army will have to rely almost exclusively upon helicopters to fulfill its missions—and this at an exorbitant price.

He added:

"In any given payload class, a helicopter generally costs at least twice as much as an airplane initially, and five times as much to maintain. The Army has further indications that the heavier categories of conventional helicopters—above three tons payload—will be extremely difficult to maintain at any cost under field conditions."

The Army, Gavin said, wants to augment its development of aircraft up to the 50,000 lb. field.

"Between 50,000 lb. and zero, there is an enormous field unexplored. Perhaps with a short takeoff, a vertical takeoff, many great things could be done."

Gen. Gavin said the weight limitation also had served to lessen the aircraft industry's interest in developing aircraft for the Army. "I have sensed a decreasing interest in the Army and its aviation problems within industry. The net effect will be that the exchange of ideas between the Army and the industry will tend to be stultified. . . ."

Under questioning, Gen. Gavin said that, while the Army might not press for operational use of a 1,500 mile missile, "we know we will need ranges of 300, 400, 500, or 600 miles."

Rep. George Mahon (D.-Tex.), chairman of the Appropriations Subcommittee on the Armed Forces, said Wilson's directive limiting the Army to a 200 mile operational missile "really means very little." The Army, he added, "will continue to work on the program as it believes it should work, without too much recognition of the 200 mile limitation, feeling that if you have the weapons and capability and the requirement, you would probably get what you want in that area."

Navy Testimony

To this Gavin replied: That is our "optimistic hope. Unfortunately, the facts of life are not quite up to that, and psychologically we are a bit inhibited in that scientists are inclined not to support our programs. . . ."

Gavin concluded that "technically, one must realize the memorandum will be outdated in time."

Chief of Naval Operations Adm. Arleigh Burke told the committee that the Navy expects to gradually convert to a ship-missile system which will involve a substantial cutback in fighter requirements. The heart of the Navy project is the Polaris fleet ballistic missile.

Adm. Burke said "missiles will be the major defense of the fleet against air attack in about the 1965-67 era. We hope to have enough ships to form a complete task force with nuclear power by 1970. . . .

"The fleet ballistic missile is in an experimental stage. We do not know for sure that it is going to work. We will not know for two or three years. But when it does, it will have a terrific impact on our various seagoing forces. . . ."

Adm. Burke said "the first difficulty that we have to overcome is to find the exact location of the launching point, so our navigational accuracy has to be improved a great deal. . . .

"The second problem is that the rolling and pitching of the ship have to be taken into account, which means that the amount of roll and amount of pitch has to be compensated for in the missile. That is a difficult problem."

He told the committee that the Navy will have a "completed job" on an atomic-powered aircraft carrier "roughly in three and a half years."

Asked why the Navy does not cut back on its manned aircraft program in view of guided missile developments, Adm. Burke said:

"Right now, it looks as if we will have manned aircraft for a long, long time.

"We are planning to reduce in a few years the number of our fighter aircraft as missiles become capable of replacing them. . . ."

Twining Views Navy

Gen. Nathan F. Twining, USAF chief of staff, admitted that the Navy's carrier aviation "can help" on a strategic striking mission. He added, however:

"But the carrier is not adapted to that role, and that is where the disagreements arise.

"I do not think there is justification for building carriers to perform the strategic air mission assigned to the Air Force."

Carrier forces, Gen. Twining testified, "are not only vulnerable to bombing attack but are susceptible to submarine attack as well. . . . A carrier force is more vulnerable, actually, than a land target. . . ."

Noting that Russia has more jet fighters in operational units than the U. S. Air Force, Secretary Donald A. Quarles added that "moreover, they have produced in the last five years more total jets than we have."

Twining Opposes Budget

Washington—Air Force Chief of Staff has admitted publicly for the first time that he is opposed to the administration's $17 billion budget for USAF during Fiscal 1958. In testimony before the House Appropriations Committee, Gen. Twining said:

"I felt a $21 billion program was the minimum essential program for the Air Force, and that is the way I presented it to Mr. Wilson."

Earlier, while indicating that he thought the budget should be somewhat higher, Gen. Twining told the House Armed Services Committee that the budget would provide a "wise and reasonable degree" of protection. He added at the time that "I accept this budget and I support the force structure . . ." (AW Feb. 4, p. 25).

SECOND P6M-1 taxis in Chesapeake Bay. Cause of crash was traced to the effect of experimental horizontal tail modification.

P6M Crash Study Leads to Tail Solution

Flight tests of the Martin P6M SeaMaster are expected to resume in the late fall, and production of the multi-jet seaplane, which is now under way here, will incorporate design changes in the aircraft's tail.

The following Martin report of the crash of the second airplane, reprinted here by AVIATION WEEK, *reveals that an experimental modification to the horizontal tail changed the load level on the stabilizer actuator. Overpowering of this actuator caused the accident.*

To provide for the aerodynamic improvement brought about by the stabilizer modification, while at the same time providing corrective measures to prevent the possibility of overpowering the hydraulic system on future P6Ms, the tail assembly of the SeaMaster thus is being redesigned. The exterior configuration of the new tail, however, will largely resemble the configuration of the two J71 powered XP6M-1 seaplanes.

Tooling is under way for six evaluation P6M-1s and for more than a score of P6M-2 production SeaMasters, which will be powered by four Pratt & Whitney J75 turbojet engines. The first of the P6M-2 aircraft is expected to be delivered to the Navy in the spring of 1958.

Navy's second prototype XP6M-1 Martin SeaMaster (Buno 138822), world's first multi-jet seaplane, was lost on its twenty-fourth test flight south of Wilmington, Del., on 9 November 1956 at 1536 EST. All four crew members ejected successfully and parachuted to the ground east of Odessa without injury.

The airplane took off from Chesapeake Bay near the Martin plant at Middle River, Md., at 1444 EST. A pass at 1,000 ft. was made over several small company boats containing Naval visitors who had witnessed the take-off. After doing acoustical tests at 5,000 ft., the airplane climbed to 12,000 ft. where two successive openings and closings were performed with the hull rotary mine door.

After a climb to 25,000 ft., the ship was put into a slight dive. At about 20,000 ft., a normal recovery to level flight was begun. A nose down pitch was felt by the pilot, however, and the latter exerted column force (pull) for correction. The airplane then began to respond and column force was gradually released.

No Response

But the climb continued and increased in rate as the pilot applied increasingly greater opposite control (forward column pressure). The airplane still did not respond. While subject to somewhat greater than nine times the force of gravity, it continued to pitch up in a tight inside loop.

Pilot of a Navy jet fighter chase plane, immediately behind the P6M, observed the pitch up to an approximately vertical position. Upon sighting some small unidentified parts falling off behind the SeaMaster, he radioed that the plane was breaking up and for the crew to eject. All four members ejected successfully during the loop, after which the aircraft fell into a downward spiral to an estimated altitude of 5,000 ft. where an explosion took place, followed by complete breakup. The wreckage fell among fields and small wooded areas near Odessa.

SEAMASTER HISTORY

In April, 1951, the Chief of Naval Operations issued an operational requirement for a high-performance all-jet seaplane that would live on the water, and be supported primarily by tenders. Martin's award of the contract, and the subsequent development of the P6M, was described to Congress on June 1, 1956 by the Deputy Chief of Naval Operations (Air) as follows:

> **"The original contract with the Glenn L. Martin Company called for two XP6M aircraft, the first of which made its initial flight in July 1955. This aircraft was 'flight-test instrumented' only—in other words, it did not have the electronics equipment which will be necessary to carry out the mining mission. As the No. 1 XP6M continued with the various phases of flight evaluation, flight test data showed equal or superior performance as regards the design criteria for such an aircraft.**
>
> **"Additional production prototype aircraft were funded for in the fiscal year 1956 funds in order to have a sufficient quantity of aircraft for evaluation in 1957. A number of production P6Ms were placed on the fiscal year 1957 procurement list, but it will be a few years before we have them in operational quantities."**

On Dec. 7, 1955, after completing over 37 hours of flight time the Number One XP6M-1 prototype was lost over the mouth of the Potomac River west of Point Lookout during a test flight. Three Martin crew members and a naval officer lost their lives in this accident. From Dec. 8, 1955 until March 2, 1956, full-fledged salvage operations were conducted by naval vessels in the Potomac River.

Approximately 80 per cent of the aircraft in thousands of small parts and 193 major parts was recovered from depths ranging from 50-70 ft. The wreckage was set up in the operations hangar at the Naval Air Station, Patuxent River, Md., and analyzed thoroughly by Martin engineers and experts from the Navy, Air Force, National Advisory Committee for Aeronautics, and Civil Aeronautics Board. The accident was attributed to a con-

trol systems malfunction in flight which caused a sudden severe nose down pitch and resultant failure of the wings in negative bending.

Following is a description of the first XP6M-1 accident as given to Congress on June 1, 1956 by Rear Adm. James S. Russell, Chief of the Bureau of Aeronautics:

> **"Very briefly, the horizontal tail, which is completely hydraulic-controlled, went full up, suddenly, and the airplane broke up by doing the beginning of an outside loop. The engines came out about nine times the force of gravity, and went straight ahead. The wings bent completely down, and the underside touched the fuselage, and we think then they broke by clapping underneath the airplane. But it was due to the sudden swing upward of the horizontal tail. Something went wrong in the hydraulic control, or something else in the control system."**

Possible causes of the control system malfunction were listed at the time as: a minor explosion in the center wing stub which may have damaged control cables, hydraulic lines, or electrical circuits; a broken or snagged control cable; loss of pilot feel-force in the longitudinal control system; loss of one or two duplicate hydraulic systems, coupled with the overpowering of the remaining system; and elimination of hydraulic power from the stabilizer actuator.

As there was insufficient evidence to label any one of the above as the single, indisputable, most probable cause of the accident, corrective action was taken to cover each instance prior to first flight of No. 2 XP6M-1. Among the revisions incorporated: the mechanical and hydraulic control systems were re-examined and additional margins of safety were provided beyond the design system; crew escape methods were reviewed and provision was made for ejection of all crew members.

Flight History

No. 2 XP6M-1 made its first flight from Chesapeake Bay on May 18, 1956. More than 42 hours of successful flight tests had been accomplished with this airplane at the time of its loss. The combined flights of both SeaMasters had qualitatively established flight characteristics of the airplane over a considerable range of center-of-gravity locations, altitudes, and speeds. The pilots have expressed unusual satisfaction with airplane control characteristics.

The second XP6M-1 SeaMaster, like the first, had manifested inflight vibration over some speed ranges, and a continuous effort had been made to locate and eliminate these vibrations. On almost every flight of Ship 2, some change in configuration, or addition of tufting was made and its effect studied.

On the final flight, the horizontal tail configuration was changed by locking the elevators in a fixed neutral position, rather than leaving them geared to the stabilizer in their normal manner as on all previous flights. This experimental modification was another in the series of steps to eliminate vibration.

The investigation was planned and directed by a committee of Martin engineers, each specifically chosen for a particular job. These included XP6M-1 group engineers, staff design engineers, and several section heads detached from their regular duties. This committee directed the work of approximately 100 technical people, assigned to the investigation for varying periods. In addition, others from engineering, manufacturing and other divisions of the company, while not directly assigned to the investigation, provided data, services, or advice to the committee.

To assure the objectivity of the investigation, the committee availed itself of the aid of representatives of the following: the Bureau of Aeronautics, the Naval Aviation Safety Center, Naval Air Development Center, Naval Research Laboratory, National Advisory Committee for Aeronautics, Civil Aeronautics Board, Aluminum Co. of America, Frankford Arsenal, Allison Division of the General Motors Corp., and the Martin Company subsidiary, Research Institute for Advance Studies.

WRECKAGE

Approximately 95% of the wreckage has been recovered. Ninety per cent of the recovered items, including all major structural components, were picked up within a half-mile radius. The remainder of the items were recovered within an area of approximately 15 sq. mi. with a linear spread of seven miles from the aft hull section to a small piece of wing trailing edge.

Eight of the ten wing leading edge slats were recovered and found between five and six miles south-east of the main wreckage area. The left-hand outboard spoiler was recovered in two sections, between six and seven miles southeast of the main wreckage area. One small piece of an engine access door was also found in the latter area. The crew ejection seats and hatches were found approximately 3½ mi. from the main wreckage site.

The fields, extending approximately 1½ mi. east and north to the main wreckage area, were strewn with small pieces of wreckage from all parts of the airplane. The winds were from the northwest and light pieces would have drifted to the southeast as they fell.

STATEMENTS

Statements of the crew and chase plane pilots were taken by tape recorder on the evening of Nov. 9, 1956 only a few hours after the accident. On the following day, written statements were prepared by each man. In each case, the recorded and written statements basically agree, and give the following picture of the accident:

Vibration tests had been carried out at 20,000 ft. while constant speed points were recorded. The pilot reported that the airframe vibration was decidedly less, and the control monitor requested a climb to 25,000 ft. with a descent to reach the maximum speed of previous tests. This was done, and during the descent the co-pilot monitored the engine instruments and hydraulic system pressures, and reported everything normal.

Decision to Eject

The pilot then reduced power to 90% rpm. and started a mild pullup to slow down gradually. A nose-down pitching tendency occurred, and the pilot applied full force. The ship responded to the control but continued the climbing maneuver at an increasing rate. The pilot applied increasing forward stick force, until the stick was at full arm's reach, and still the airplane did not respond.

G forces became so heavy that his chin was forced down on his chest. He then decided the airplane had failed aft, and elected to eject. After ejection, the pilot said he observed the airplane to be "all in one piece."

Co-pilot's report, obtained independently, is consistent with that of the pilot.

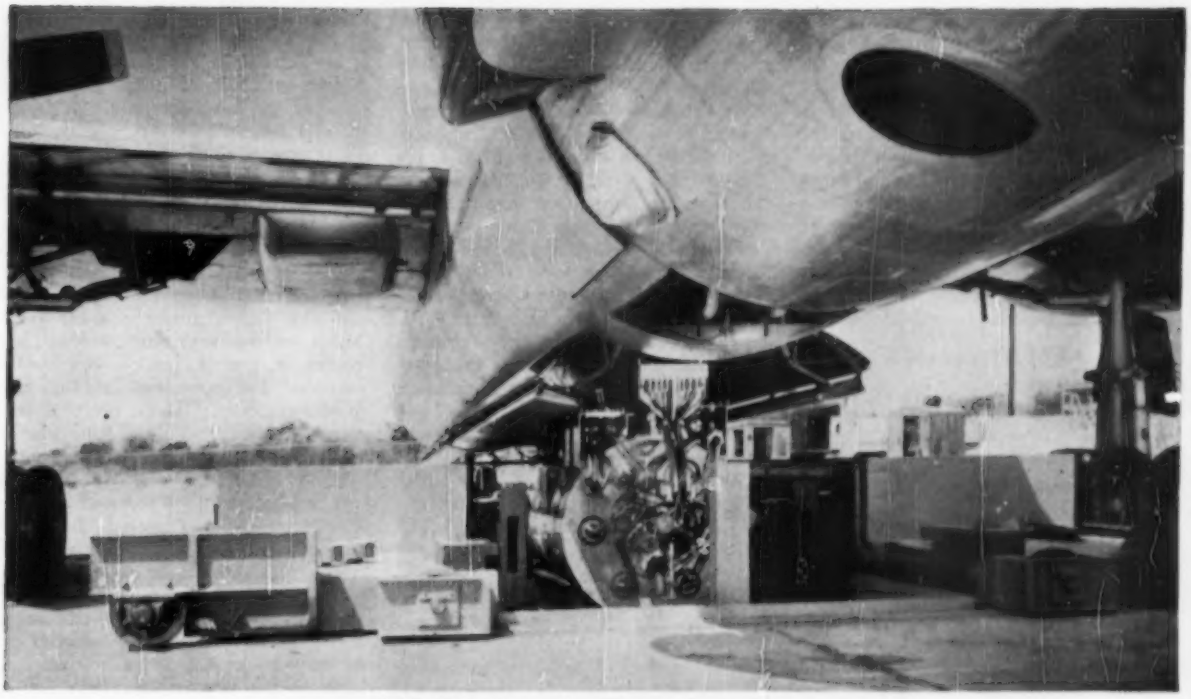
The chase pilot, O. F. Brown, reported that he was following the aircraft at a distance of about 300 yd. He observed that the ship pulled up to a level flight faster than normal and climbed rapidly, continuing on over beyond the vertical. At this point he radioed that the plane was breaking up and for the crew to eject.

Then the ship passed over his shoulder and he lost it in the sun. He next observed it in a descending spiral aft of his starboard wing. He saw undefined parts break off during the initial pitchup, but at no time did he see major components break away. He stated: "The wings, fin, stabilizer, wing tip floats, fuselage and engines all remained intact until the airplane exploded and burned at an estimated altitude of 3,000 or 4,000 ft."

INSTRUMENT RECORDINGS

Data collecting devices which were aboard the aircraft have provided all the basic information needed to provide the necessary answers as to the cause of the accident. This information is considered both reliable and consistent as a basis for the conclusions reached in the committee's report.

Two principal sources of data used in the crash analysis were the forward



NB-36 Loads Test Reactor

Low power nuclear reactor designed and built by General Dynamics Corp. is loaded into fuselage of NB-36, used in nuclear aircraft test program. Reactor, rated at 1 megawatt (AW Aug. 6, 1956, p. 174), is used to test shielding of crew, equipment and aircraft systems. Program is part of USAF WS-125 program concerned with the overall nuclear aircraft propulsion problem.

oscillograph, on which measurements were being recorded for use in the vibration elimination program, and the telemetering system which was used for ground monitoring and backup.

Telemetering installation consists of an ASCOP PWM system for monitoring positions, airspeed, altitude, and pitch and roll. The output of this system was fed into the 70 kc. subcarrier oscillator of a conventional FM/FM telemetering system. In addition, seven other FM channels were used for measurement of acceleration data and for monitoring pilot comments. With the exception of the right wing accelerometer, which was not operative during this flight, data was recorded on all the remaining channels.

All data during this particular flight was recorded on magnetic tape in the base station and was being presented for visual display on direct-writing Sanborn recorders at the Martin Company Airport. The records were being monitored at the time of the accident by flight test and other engineering personnel.

The records compiled from the telemetering data take into account the various normal corrections, sources of error, and radio noise. Worthy of particular attention is the fact that these telemetering records continued for 55 sec. after the airplane reached the maximum pitch acceleration. Thereafter, transmission was lost. This indicates that the major structural break-up occurred after the maneuver.

STRUCTURES

Telemetering information, statements by crew members and chase pilots and location of wreckage all indicate that there was no failure of major structural components until the aircraft had completed its inside loop maneuver.

Special emphasis was placed on an examination of those components which could contribute to a control system failure. Among the areas considered: the left hand elevator locking device, the stabilizer structure supporting the left hand locking devices, the reinforcement doubler just inboard of the locking device on the stabilizer, the left hand elevator at mid-span; the left hand elevator at the closing rib, the main trunnions attaching the stabilizer to the fin and all supporting structure relating to the mechanical control system.

One possibility was considered because of the improved vibration condition on the final flight. Since locking the elevators appears to be the reason for improvement, it was considered that the vibration energy was being absorbed by the locking devices and its supporting structure. If this had resulted in a failure, it would have been a fatigue type of relatively high cycles–low stress. The aerodynamic loads on the elevator for the locked condition are essentially zero. There was no evidence of fatigue in any of the failed structure.

Examination of the stabilizer bonded structure revealed that failure occurred from very high shear stresses along the edges. There was evidence of some peeling action near the center of the panels from the aft to forward direction, and in some areas, of material failure prior to the unbonding. There was no evidence of insufficient bonding strength.

CONTROL SYSTEMS

Both flight control hydraulic systems are believed to have been pressurized and operating at the time of the aircraft pitch up for the following reasons:

- **System pressures** were monitored by the co-pilot from 15 to 30 sec. prior to the accident and he reports that the pressure was normal.
- **Condition of the stabilizer** systems from their accumulator check valves up to the cylinder indicates that the lines and components were intact until late in the break-up sequence.

There was no evidence found to support the initial assumption that the uncontrolled pitching maneuver had been caused by a control system malfunction. A complete survey of the longitudinal control system revealed all failures to be of the static tension and

bending type. The majority of the fractures clearly occurred on ground impact. The stabilizer cylinder control valve casting had an internal failure at the base of the inner valve port. Much emphasis was placed on the nature of this fracture early in the investigation. However, microscopic analysis and functional laboratory tests indicated this failure resulted from a static load at break up. These findings were confirmed by Aluminum Company of America casting specialists, as well as by government experts.

AERODYNAMICS

The XP6M-1 is the first large aircraft to be designed for high speeds at low altitudes. As a result, the XP6M-1 must be given the ability to withstand airloads two or three times as high as any existing aircraft of comparable size.

But these factors have opened a realm of unknowns for the aerodynamicist. For the XP6M-1 has been conducting exploratory developmental flight tests in a speed region where little is known about the aerodynamic forces involved for planes of this size, weight and speed characteristics, and where sudden and sometimes unexpected force changes can occur with increasing speed. Further, the aircraft's flight envelope has made difficult any accurate prediction of the magnitude, direction, and particular flight conditions at which these force changes may occur.

Evidence in this investigation indicates that the possibility of error between aerodynamic calculations and actual flight test results is quite great in this realm of flight testing. Particularly is this true for an aircraft such as the XP6M-1 where the so-called "100% boost" control system allows for no "feedback" of forces to the pilot.

Feel Eliminated

Design and perfection of such control systems is a necessary forward step in aviation progress, but it also means development of aircraft in which we are destroying one of our senses, namely the "feel" of aircraft movement normally experienced by the pilot. Loss of this feedback force means an inability on the part of the pilot to report to designators a true indication of what the aircraft has experienced in flight, and the only substitute is use of adequate and continuously monitored instrumentation.

Examination of telemetered data following the accident shows that, in recovering from the dive to the maximum observed speed, the stabilizer moved to a full leading edge down position, resulting in the airplane rapidly trimming up to a normal load factor of more than nine times the force of gravity.

As a result a complete re-examination of all flight and wind tunnel stabilizer hinge moment data was initiated, and dynamic analyses were begun, using automatic computing equipment in an effort to simulate the final climbing maneuver, and to investigate hinge moment variations under dynamic conditions.

Configuration of the XP6M-1 on its last flight was not standard in that the elevators had been locked in a fixed neutral position, eliminating elevator deflection (trailing edge up) which exists at high speed trim conditions in the normal configuration where the elevators are geared to the stabilizer. With the elevators locked to the stabilizer, the hinge moments shift in the compression direction, or to the weaker side of the stabilizer cylinder.

Revised calculations, on the basis of corrected data, indicate that, with zero elevator deflection, the stabilizer hinge moments could have approached, or exceeded, the maximum capacity of the stabilizer actuator at the maximum speeds attained at the time of the accident.

Critical Load

Analyses on the automatic computing equipment have shown that, with the elevators locked, the stabilizer motion will still continue in the nose down direction after an initial small overpowering of the hydraulic system. Hence, the evaluation of wind tunnel data and, in addition, the corrected measured stabilizer loads (under locked elevator conditions) indicate the same thing. The hinge moment level was very close to the compression capacity of the stabilizer actuator at the time that the last speed reading was taken. Only a slight disturbance, such as the pilot's pulling out of a dive, or a gust, was needed to overpower the stabilizer actuator.

Relative to the loss of the Number One XP6M-1 over the Potomac River in December, 1955, the revised hinge moment data in the present accident investigation of the second airplane indicate that, at the conditions under which the first aircraft was lost, the stabilizer hinge moments were not an initiating cause of the earlier accident, unless coupled with other factors.

FINDINGS

The results of the present investigation have revealed no evidence of any basic deficiencies in the aerodynamic design which might reduce the potential capability of the P6M aircraft to perform its assigned mission.

Crew members on the second XP6M-1 at the time of the accident were Robert S. Turner, pilot; William Cunningham, copilot; Thomas Kenny, flight test engineer, and William Compton, flight engineer, all employes of Martin.

- **Aircraft was lost** because of an uncontrollable nose up pitching maneuver which occurred during a shallow dive at an altitude of about 20,000 ft.
- **Horizontal tail** configuration had been changed for this flight only by locking the elevators in a fixed neutral position. This experimental modification eliminated elevator deflection (trailing edge up) which exists at high speed trim conditions with the normal tail configuration, in which the elevators are geared to the stabilizer.
- **Aircraft** had been tested on several previous flights under conditions of Mach number, dynamic pressure, and center of gravity, which equalled or exceeded the conditions at the time of the accident. These previous tests were with the design tail configuration (elevators geared to stabilizer), and no adverse control characteristics had been experienced.
- **Stabilizer hinge moment** characteristics change substantially at high Mach numbers, and with the elevators locked to the stabilizer, these hinge moments shift in the compression direction, or to the weaker side of the stabilizer cylinder. Revised calculations, on the basis of corrected data, indicate that with no elevator deflection, the stabilizer hinge moments approach, or exceed, the maximum capacity of the hydraulic control system at speeds as high as those attained at the time the second XP6M-1 accident.
- **Analyses** since the accident on automatic computing equipment have shown that, with the elevators locked, the stabilizer motion will still continue for a short time in the nose down direction after an initial small overpowering of the hydraulic system.
- **Ample and conclusive** evidence was provided by in-flight recordings of data collecting devices, particularly the oscillograph and telemetering systems.
- **Evidence** that the airplane did not break up until well after the pitching maneuver is provided by: 1) statements from the XP6M-1 pilot and the pilot of the jet fighter chase plane; 2) the continued telemetering recordings for 55 sec after the pitching maneuver; 3) the fact that the major portion of wreckage was recovered in a small area of only a half-mile in radius.
- **No evidence** of pilot error, structural failure, or initial malfunction of either the airplane control system or the flight control hydraulic system was found.
- **No apparent direct** connection between the accidents of the Number One and Number Two XP6M-1 aircraft were found. The evidence reveals that they were separate and distinct as to cause.
- **Revision** of the wind tunnel hinge moment data in the present investigation indicates that, at the conditions under which the first XP6M-1 was lost in December, 1955, the positive stabilizer hinge moments (tension in cylin-

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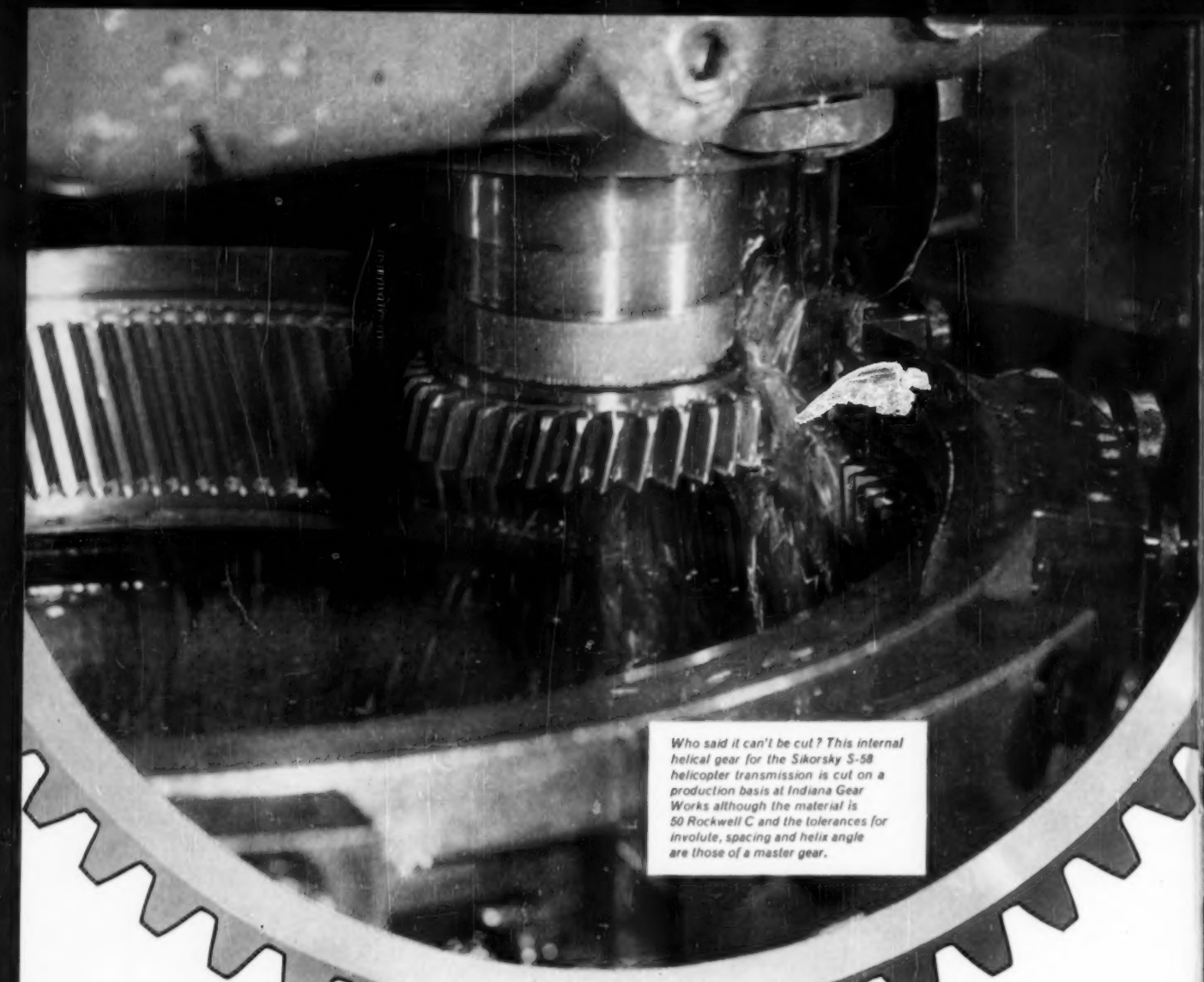

Who said it can't be cut? This internal helical gear for the Sikorsky S-58 helicopter transmission is cut on a production basis at Indiana Gear Works although the material is 50 Rockwell C and the tolerances for involute, spacing and helix angle are those of a master gear.

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der) were not an initiating or contributory cause of that earlier accident.

• **Within the flight limits** tested to date, no serious functional, design, or flying deficiencies were found which might have contributed to the accident.

CAUSE

The investigation committee has concluded that the cause of the second XP6M-1 accident was the fact that the airplane was flying with an experimental modification – locked elevators – which changed the load level on the stabilizer actuator. When the aircraft attained high speed and commenced recovery from the dive at about 20,000 ft., the hinge moments acting on the stabilizer overpowered the stabilizer actuator, with the resulting uncontrollable climbing maneuver.

Maser Development Offers Wider Uses

A semiconductor amplifier device called the Garnet Maser which appears capable of operating over a remarkably large frequency range of 50 mc. to 100,000 mc., has been developed by scientists at the Bell Telephone Laboratories and Harvard University.

It operates on principles similar, but not identical, to the Paramagnetic Masers recently announced by BTL and the Massachusetts Institute of Technology (AW Feb. 18, p. 67). However, the new device can operate at room temperature instead of the extremely low (near-absolute) temperatures required for previous Masers.

This characteristic, plus the device's relatively small size, opens the way to possible use in airborne radar and communications. Noise level of the Garnet Maser when cooled is comparable to that of earlier types, but is higher when operated at room temperature.

Another significant advantage of the Garnet Maser is that it can be operated as both a continuous wave (CW) and pulsed amplifier whereas some Masers are limited to pulsed operation.

Credit for conceiving the Garnet Maser is given to Dr. Harry Suhl of BTL, by Dr. C. L. Hogan of Harvard, who independently made the same discovery at a slightly later date. Dr. Hogan says the new device has "very exciting possibilities." Although considerable engineering problems remain to be solved, Dr. Hogan believes that a competent industrial organization could produce prototype models within six months if work is started at once.

Under Air Force sponsorship, Harvard has been investigating garnet materials. Of the dozens of possible compounds, it appears that only a few will prove suitable for Maser use, Dr. Hogan says. One of these which appears most promising is a combination of yttrium oxide and iron oxide, in proportion of 3:5. The mixture is sintered under high temperature to produce the Maser material.

Asked about the gain and bandwidth of the new Garnet Maser, Dr. Hogan says that the device operates somewhat like a superregenerative receiver where the gain is dependent upon the stability required. However, he believes the device should be able to provide at least a 30 db. gain with reasonable stability.

Garnet Maser bandwidth at lower frequencies, around 300 mc., should run about 1-2 mc. Very little is presently known about the relation of bandwidth to operating frequency and bandwidth may prove to be relatively independent of operating frequency, Dr. Hogan told AVIATION WEEK.

One possible limitation of the new device, when operated at extremely high frequencies, is the requirement that its power source must be at a higher frequency than the input signal which the device is to amplify.

Large Solar Furnace To Be Built by ARDC

Holloman AFB, N. M.—Large solar furnace capable of producing temperatures between 6,000 and 8,000F. will be built by USAF's Air Research and Development Command in the Sacramento Mountains of south-central New Mexico near Cloudcroft. Target date for completion is early 1959.

Described by ARDC as the "world's largest" solar furnace, the facility will be employed primarily to study the effects of rapid temperature changes on metals used in missile structures.

Management of the furnace will be taken over by Holloman Air Development Center. It will be available to the Army, Navy, Atomic Energy Commission, National Advisory Committee for Aeronautics, industries engaged in defense work and the Air Force.

The facility will be composed of three basic parts:

• **Heliostat,** the primary sun-reflecting mirror, which will be 130 ft. high, 140 ft. wide.

• **Parabolic mirror,** which collects the sunlight and concentrates it onto the focal point.

• **Attenuating shutters,** a venetian-blind type device which regulates the amount of sunlight traveling from the heliostat to the parabolic mirror.

Sun rays strike the heliostat and are reflected to travel parallel to the ground. The parabolic mirror then collects the rays and reflects them to the focal point of the paraboloid. By this method, the energy can be increased from .028 to 700 units per square centimeter.

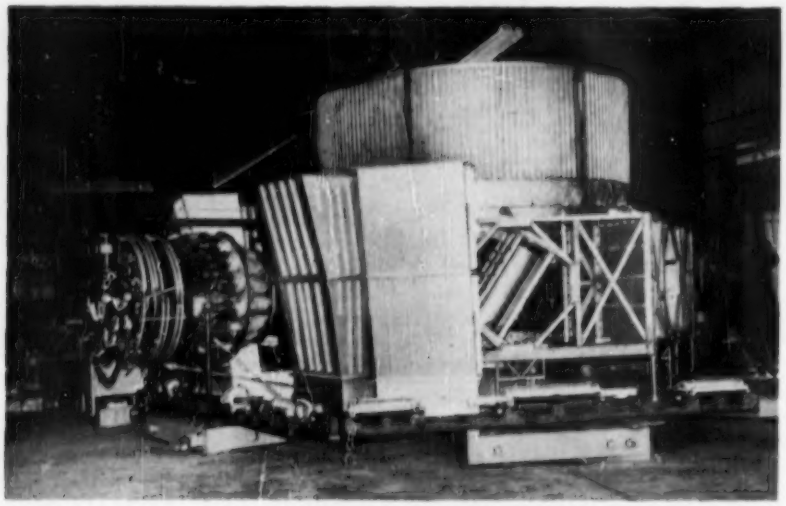
The furnace will require a staff to approximately 100 persons to be supplied by Holloman and civilian contractors. Developer of the design theory to be used was Dr. Paul Jose, director of Holloman Air Development Command's Materiels Branch.

In another development, Hoffman Electronics Corp., Los Angeles, established a Solar Research Division in Evanston, Ill., which will be concerned with the development and production of solar energy converters. It will operate as a part of Hoffman's Semiconductor Division-Evanston.

Company also has set up within its subsidiary, Hoffman Laboratories, Inc., a new department for research and development of semiconductor applications, called the semiconductor equipment design section of Hoffman Laboratories. Unit will develop apparatus using all types of semiconductors.

TWO ARDC scientists, Dr. Knox Millsaps and Dr. Paul D. Jose (right), view furnace model.

AD-4 being launched by All American's turbo-cat (behind plane) has short takeoff run.



TURBO-CATAPULT under construction. One of six Allison J33s used is shown at left.

New Catapults Developed for Navy

Two new devices have been developed for launching planes in minimum distances.

One is designed for use on short, land-based strips being operated by the Marine Corps. Called a turbo-catapult, or turbo-cat, it uses jet engines to launch jet (and piston-engine) planes into the air in one fifth of their normal takeoff runs. Device was designed and manufactured by All American Engineering Co.

Other, developed for Navy carrier use and called an Internal Combustion Catapult Powerplant, is designed to produce and maintain greater launching pressure at faster rates than any equipment now in existence according to the maker, Reaction Motors, Inc. ICCP will be installed at the Naval Ship Installation Test Facility, Naval Air Station, Lakehurst, N. J. for a two year development and evaluation test program.

All American's turbo-cat launcher, which develops 60,000 hp., yet is only one-fifth the weight of a comparable steam catapult, was recently demonstrated to Navy BuAer officials at the company's test facilities at Georgetown, Del. First plane launched was a piston-engine Douglas AD-4NA; first jet tried on the device was a McDonnell F2H2 Banshee. Pilots of both planes stated that the launcher provides smooth acceleration to take off speed.

Turbo-cat's big asset is that it is easily disassembled for air transportation to fields where it is needed. Also, since it uses standard jet engines it presents no specialized maintenance problems, and will operate on any engine fuel available. Elimination of complicated clutches and gear boxes helps to keep maintenance to a minimum. It will launch any aircraft equipped for carrier operation without any modification.

The device consists of six turbojets arranged in a circle like a six-pointed star with the engines' exhausts pointed inward. To catapult a plane, the engines are brought up to a predetermined rpm., then a flow gate is actuated which diverts the exhaust gases to impinge on one of two centrally-placed launching turbines. The turbine supplies the power to launch the aircraft through a drum and cable system which hauls a shuttle along a track in the runway. Plane is attached to the shuttle by a carrier-type bridle.

Used in conjunction with All American's "Water Squeezer" arresting gear as a system, the turbo-cat can make almost any air strip a potential jet base.

Vanguard Tests

Patrick AFB, Fla.—Two stages of the three-stage satellite rocket were fired for the first time in the Vanguard test program here last week. Navy did not disclose how far the rocket went before falling into the sea. Peak velocity was 3,500 miles an hour.

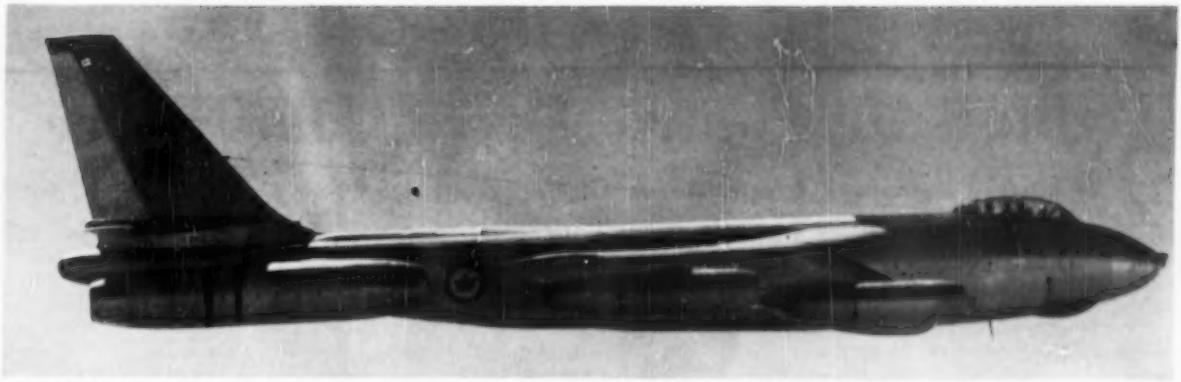
Meanwhile, the Martin Co., Vanguard prime contractor, announced acceptance of a first-stage engine from the General Electric Co. The unit will be tested at this base within a few months, the Navy said.

Pace Named President Of General Dynamics

New York—Frank Pace, Jr., has been elected president of General Dynamics Corp. and reelected vice chairman of the board. The firm's board of directors at their meeting here last week also reelected John Jay Hopkins board chairman and named Earl Dallam Johnson executive vice president.

Pace, a former Secretary of the Army and once Director of the Budget, joined General Dynamics in 1953 as executive vice president and was elected vice chairman of the board in 1955. Johnson, former Undersecretary of the Army and a recent president of Air Transport Association, in 1955 became senior vice president-operations and fiscal affairs of General Dynamics.

Hopkins, the corporation's founder and its president until Pace's election, is confined to Georgetown University Hospital by illness.



B-47 TEST bed for Orenda Iroquois engine has dorsal fin extended to bring wiring over aft fuel cells, bomb bay changes.

Test Bed Layout Dictates B-47 Changes

Malton, Ont.—Structural modifications of a Boeing B-47 test bed for the Orenda Iroquois engine included reworking navigator's and co-pilot's compartments, the bomb bay and dorsal fin, and attachment of the engine pod itself by a slightly "area ruled" pylon to reduce buffet.

Several engine locations were considered, but a major deciding factor for the rear fuselage was that it left no aircraft structure in the cone of jet blast aft, thus avoiding possible structural damage from noise. Rejected locations included slinging the engine under the wing, placing it in one of the present J47 pods, placing it in the bomb bay or burial in the fuselage.

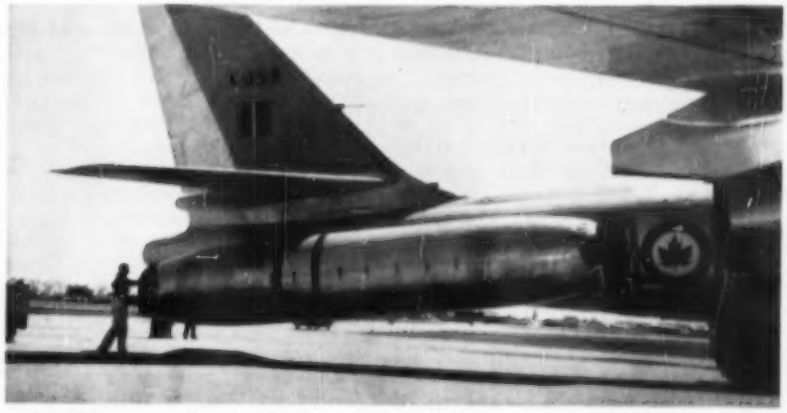
Choice of the circular pod and pylon was given careful attention to cause the least effect or penalty on performance of the aircraft.

Shake tests carried out before and after the conversion indicated that, in fact, the installation had slightly reduced wing natural frequency and had changed the previously symmetrical nodal pattern. Brief flight test program re-established the aircraft performance envelope.

Effect of the pod and pylon shape was determined by three brief series of wind tunnel tests in the Boeing transonic tunnel, Wichita, Kan.; the Convair low speed tunnel at San Diego, Calif., and the University of Wichita low speed tunnel.

Modification of the aircraft structure included

- **Reinforcement** of existing bulkheads frames, longerons and skin on the aft fuselage to handle the weight and thrust of the engine.
- **Removal** of bomb bay and forward auxiliary fuel tanks to make room for instrumentation and wiring.
- **Extension** of dorsal fin to allow passage of wiring forward of the aft fuel cells.



SLIGHTLY "area ruled" pylon to reduce buffet attaches engine pod to fuselage.

About 100,000 ft. of wiring is required for the instrumentation.

- **Construction** of rack in the bomb bay to carry the recording apparatus.

This bomb bay rack was constructed so that it could be easily lowered to the ground for accessibility by means of a winch. In addition, a vinyl plastic pressurized enclosure was built around it to eliminate any danger of an explosive mixture forming inside from the close proximity of the fuel tanks.

The following equipment was installed:

- **Temperature logger,** manufactured by Non Linear Systems of Del Mar, Calif. to Orenda specifications. This unit is capable of recording 100 temperatures in a period of 10 sec. with an accuracy of 0.2%. Its record is made on a C.E.C. magnetic tape recorder Type 5-701-28.

Since this system was evolved, considerable interest has been expressed by several American aircraft companies.

- **Pressure logger** manufactured by Wianko Engineering Co. of Los Angeles also to an Orenda specification. This unit is capable of recording 70 pressures in a period of 20 sec. with an accuracy of 0.2% and its record is also made on the same magnetic tape unit with the temperature logger. Telemetry system designed and manufactured by Orenda primarily to record 8 channels of engine compressor blade vibration. Two oscillograph packs are used as follows:
- **Pack No. 1,** 36 channel C.E.C. type 5-119 recorder and ancillary equipment to be used to record engine transients to an accuracy of 2%.
- **Pack No. 2,** 26 channel C.E.C. type recorder and matching networks to record primarily engine overall vibrations.

Two photo recorder units were designed and manufactured by Orenda. They are being used primarily for system analysis and general performance where a high degree of accuracy is not required.

All this instrumentation is automatically controlled so that the observer need only initiate the cycle. The normal cycle can be conveniently modified at the discretion of the observer by individual switching of the units.

Tighter Air Control Drive Gains Force

ATA, ALPA discuss proposal for tighter control; controllers warn that positive control premature.

By L. L. Doty

Washington—A renewed drive to extend positive control of all air traffic gathered momentum last week, but controllers warned that any such action now will only invite tighter bottlenecks on the already overtaxed airways.

The latest step toward increased positive control grew out of discussions between the Air Transport Assn. and Air Line Pilots Assn. On a plan to require IFR flights above 9,500 ft. on airways within the New York-Washington-Chicago triangle regardless of weather.

The proposal, which has been presented to airlines and their pilots by the two associations for review and comment, would also ban off-airways flights on the triangle periphery. If approved by ALPA and ATA members, the plan will be placed into effect July 1.

Air Traffic Controllers Assn. charged that the suggested plan is "premature." The association said that too stringent a positive control enforcement may add to the traffic snags that already are causing chain reactions of delays and cancellations, particularly on the high density routes and terminals areas within the New York-Washington-Chicago sector.

Aviation Week Survey

Meanwhile, an AVIATION WEEK survey of four of the major air route traffic control centers (ARTC) in the triangle showed that rising traffic volume is rapidly outstripping capabilities of facilities and trained manpower to handle it. Controllers say positive control of traffic on a large scale at this time will compound the problem even more.

Here are the major gaps in the present airways structure that AVIATION WEEK found to be the leading causes of slow-downs in the normal flow of traffic:

• **Lack of radar coverage.** Some centers such as Detroit are without radar. In such cases, out-dated standard ANC clearances are used to handle traffic movement. Chicago is equipped with FPS-8 radar but handles only the departure phase of traffic control by radar 16 hours a day.

• **Controller shortage.** The New York and Washington centers are now well equipped with radar but, because of insufficient staffs of trained personnel, are unable to maintain operations at peak utilization of facilities without relying on overtime. The Chicago center is now operating at a level 35 controllers below its approved complement. In some areas, controllers are working 60 to 70 days without a day off.

• **Low acceptance rate of airports.** No airport in the U.S. is equipped with dual parallel runways with dual ILS, a must if anticipated traffic gains are to be accommodated.

• **Lack of by-pass airways** around heavily congested areas. All traffic, for example, is now fed through the high density area of Detroit because space allocated to near-by Selfridge Field for military purposes prevent use of airways that circumvent Detroit. Airlines are asking for the addition of a by-pass airways between Saginaw, Mich., and London, Ontario, as a means of diverting through traffic away from Detroit.

Need for Action

The critical situation underscores the need for prompt implementation of CAA's six year plan for federal airways and proposals of the Aviation Facilities Planning Group. Both plans contemplate some form of positive control of air traffic on all airways. IFR governing all flights above 9,500 ft. have been in effect in Canada since June, 1956 (AW May 28, p. 37).

Under its plan, CAA has already established positive control of traffic above 24,000 ft. and plans to lower this floor to 15,000 ft. by January, 1958, on all federal airways (AW April 1, p. 47).

The Aviation Facilities Planning Group headed by Presidential Advisor Edward Curtis has recommended positive control above 18,000 ft. and a combination of IFR and VFR traffic below that level through the use of multiple one-way airways separated vertically and laterally (AW April 29, p. 39).

Both the airlines and the airline pilots have consistently advocated some form of positive control as the most efficient means of attaining safe and time-saving separation of aircraft.

The airlines have favored an approach toward positive control in easy stages by gradual modification of present procedures. ALPA, on the other hand, has pumped hard for immediate control of traffic as the best, if not the only immediate, safeguard against a disorderly conduct of air traffic.

Pilots feel that the best way to determine capability of the airways to handle positive control is to put the system to test at once. They have chosen the triangle as a starting point since they claim it has the best airways structure, best trained controllers and the best facilities and equipment.

One ALPA spokesman admitted that delays in flights may be encountered during the first few days of July if the new procedure goes into effect on July 1.

He maintained, however, that delays will decline once pilots and controllers become adapted to the system. He said the procedure will also prepare the airways system for better handling of traffic once adverse weather hits the area next winter.

ALPA concedes that 1,000-on-top VFR flights may continue during the early phase of the introduction of IFR procedures. But the group is convinced that the present airways system can handle the proposed procedure, and it cites the success attained in the implementation of the high density traffic zone at Washington.

If the plan is adopted, ALPA will likely call for more efficient use of present facilities simplification of procedures. For example, nine fix postings are now required on flights between New York and Washington. Pilots feel that the one fix posting suggested by the Curtis group is adequate and will reduce controller workload.

The union found in a recent survey that flights on the same altitude between New York and Washington are separated by as much as 52 minutes, permitting but one en route flight between the two points at any given altitude.

CAA Program

CAA already has embarked on its program to add 70 airport surveillance radars during the next six years to augment the 45 now in operation. Long-range radar, key to the "spot-basis" of aircraft separation to break bottlenecks, is scheduled for installation in 1958 or 1959.

The CAA has also launched a high-speed training program for controllers that has won praise from the Air Traffic Controllers Assn. The program, tied in with an intensified recruiting campaign, would relieve the controller shortage to some degree, although one controller

chief estimated it would "take two years to get caught up."

CAA has established an Airway Traffic Control Inspection Division that will send a team of nine control experts to various centers to evaluate methods and procedures now in effect. Headed by Donald Long, the team will make recommendations for the improvement of the air traffic control system with present facilities.

CAA admits that "today's system was built with the resources of yesterday and is unable to cope with the demands of traffic today." CAA officials have not fully analyzed the ATA-ALPA proposal to determine in advance whether positive control in the triangle will function without flight delays.

Most CAA officials, however, are dubious over the outcome, although they have expressed a willingness to put the experiment to trial. They say that traffic becomes bogged under IFR conditions when weather is bad and express doubts that this situation will improve when weather is good. They also add that heavy VFR traffic, not present under standard IFR conditions, may complicate traffic flow when voluntary IFR traffic must also be handled.

Delays Cited

Here are a few examples of delays in traffic at the Chicago airport during IFR conditions last winter:

• **November 25:** Between 4 p.m. and midnight, reported ceilings were between 1,500 and 2,000 ft. with visibility ranging between one and one-half to two miles. At 8 p.m. the Chicago center advised that traffic delays might reach two hours and, at 10 p.m., traffic to both Midway and O'Hare airports was shut-down until 1 a.m. without any reported change in weather.

• **November 15:** Chicago Weather Bureau reported broken clouds at 1,600 ft., an overcast of 5,000 ft. and visibility five miles or better. The center advised that inbound flights to Midway were being delayed two hours.

• **October 31:** Between 4 p.m. and midnight, Chicago reported 10,000 ft. and three miles visibility. Delays due to air traffic control were reported to be two hours or more, although they actually varied between 15 minutes and one hour, 15 minutes. Flights which were not airborne at the time flow control restrictions were placed into effect were unable to get clearances out of many eastern cities such as Pittsburgh and Cleveland.

The acceptance rate at the Chicago airport probably can be charged as the primary cause of the inbound delays in most instances. Most aircraft, fully grossed, are confined to the long, ILS runway at Midway and avoid the shorter runway available for alternate takeoffs.

Approaching aircraft are forced to use the sole ILS runway, thus restricting both landings and takeoffs to a single runway operation.

Shortage of trained controllers plus frequent poor weather along the Lake Michigan shore—as contrasted to more favorable weather in the airport area—also can be attributed to the flow control restrictions.

The Chicago tower is fully equipped with Precision Approach Radar and both inbound and departure airport surveillance radar control.

The Detroit (Willow Run) tower has in-bound radar control but no outbound or departure radar. Implementation of the latter is expected sometime this fall.

There is no radar equipment in the Detroit air route traffic control center, although November has been set as the target date for the installation of the necessary facilities.

Airways Block

Major airways block in the Detroit area is the Selfridge Field RAPCON. This calls for coordination of traffic flying on Victor airways 84 between RAPCON and the Detroit center. This means that no flight will operate through the area without a release of altitudes by the Selfridge RAPCON.

Also on Victor 84 is a scramble corridor reserved at all altitudes between 13,000 ft. and 18,000 ft.

American Airlines recently proposed the relocation of the omnirange at Selfridge to the south in order to create a by-pass route around the Detroit terminal area. Both Northwest and Capital Airlines have protested the funneling of through traffic through the heavily congested area.

Best solutions to the problem appear to be a new airway from Saginaw, Michigan to London, Ontario, or an extension of Victor 221 airways to intersect Victor 84 to permit the by-passing of some traffic from the Detroit terminal sector.

A local Detroit problem is caused by jet operations at near-by Wayne County Airport which intersects the Willow Run ILS approach path.

The CAA points out that, although the New York-Washington-Chicago triangle is one of the best equipped airways sectors in the U.S., it is also the fastest growing.

Since the Civil Aeronautics Board adopted its "more competition" program of airline expansion, route awards within the triangle area have been, with few exceptions, more voluminous than elsewhere.

Airlines authorized to operate between New York and Washington have been increased from three to nine in the past two years. The Chicago-New York route has seen a rise from three authorized airlines to five in the same time. Detroit-New York has had a similar growth. Boston-New York has jumped from three to six and Chicago-Philadelphia from two to three. Chicago-Washington has remained the same, although increased competition figures in pending CAB cases.

ILS Increase

Instrument approaches handled by the CAA have increased at an annual rate of 67,800, 22%, during the last ten years. More than 50% of all IFR flights are under 200 miles in range. Statistics further show that most VFR flights have short-haul characteristics and that long-haul flights numerically constitute a small portion of en route air traffic.

Most en route IFR traffic now operates between points that include a significant volume of the VFR air traffic.

Chicago Midway Airport continued to hold first place in the number of aircraft operations handled by CAA control towers during 1956. LaGuardia Field was second in terms of air carrier and itinerant operations with Washington in fourth place closely behind third place Los Angeles International Airport.

Northeast Stock Leak Probed

Washington—Robert F. Snodgrass, a Republican Party leader in Atlanta, Ga., made a $2,500 profit in a quick purchase and sale of Northeast Airlines' stock last August after receiving information indicating that the Civil Aeronautics Board had awarded the carrier a New York-Miami route, according to testimony before the Senate Permanent Investigating Subcommittee last week.

On August 2, the CAB voted in executive session to grant the route to Northeast. Although CAB's decision was not made public until August 10, there was a sharp upswing in Northeast stock transactions on August 3. From approximately 500 transactions on August 2, the trading jumped to 24,000 shares on August 3.

Information that Delta Air Lines would not be given the Miami-New York route was telephoned to Snodgrass at 8:30 a.m. on August 3 by Robert L. Griffith, assistant to the president of Delta. Griffith said he received the information late in the evening on August 2 from Robert Oliver, a member of the Washington law firm of Pogue and Neal, which represented Delta in the New York-Miami case.

Opening the investigation of the Northeast stock case, Sen. Henry Jackson (D.-Wash.), acting chairman of the

CAB Leak

Washington—Raymond Sawyer, associate director of Civil Aeronautics Board's Bureau of Operations was identified late last week as the "probable source" of a premature leak of CAB's award of a New York-Miami route to Northeast Airlines.

Lawrence Henderson, former Washington representative for Trans American Airlines, told the Senate Permanent Investigating Subcommittee that his "best recollection" was that Sawyer told him of the award on August 3, seven days before the decision was made public.

subcommittee, declared that the information on the Northeast route award was "leaked" by employes of CAB. He added that "there have been many leaks from the CAB in the past."

Snodgrass testified that, upon the indication that Delta was "out," he logically deduced that the route would go to Northeast. He emphasized that he was not told by Griffith that the route would go to Northeast.

Oliver insisted that his information concerning the route award came from "an anonymous call." Early in the morning of August 3, Merrill Lynch, Fenner and Beane, stock brokers, purchased 400 shares of Northeast stock in Oliver's name. At 3 p.m., Oliver notified his broker that he had ordered 200 shares of Northwest Airlines stock —not Northeast stock. Although there was a profit of approximately $900 in the rise of Northeast's price during the few hours the Northeast stock was held in Oliver's name, Oliver declined to accept this.

R. H. Foster, Oliver's broker, testified that he had been instructed to purchase the Northeast stock.

North Central Denied Lake Central Deal

Washington—Civil Aeronautics Board last week announced the unanimous disapproval of the acquisition of Lake Central Airlines by North Central Airlines.

The CAB action climaxes five years of litigation and hearings before the civil courts and the CAB in moves by North Central to merge Lake Central's 1,986 route miles within its organization.

Prior to the CAB decision, a U. S. Circuit Court of Appeals on March 5 upheld North Central's contract for purchase of 96% of the stock of Lake Central. The decision reversed a District Court judgement that had been sought by a Lake Central employe group.

PanAm Income Up To $14.2 Million in '56

New York—Pan American World Airways earned $14,200,000 after taxes in 1956, the company reports. Net income was the equivalent of $2.31 per share, up from $10,200,000 or $1.66 per share in 1955.

Operating revenues totaled $289 million in 1956, an increase of 21.4% over 1955. Passenger revenues were $214,700,000, up 19.5%; cargo revenues were $26,600,000, up 16.7% from the previous year.

Pan American's 1956 operating expenses totaled $266,731,000, up 18.3% from $225,380,000 in 1955.

Total of 2,592,000 passengers were carried during the year, an 18% increase, and passenger-miles totaled 3,386,000,000, an increase of 20%. North Atlantic passengers totaled 243,000, up 18.5%. Increases of 18% and 19.2% respectively were experienced on the carrier's transpacific and New York-Puerto Rico routes. Overall passenger load factor averaged 66%, up from 65.1% in 1955.

Revenue ton-miles totaled 460 million, up from 388 million.

PanAm Is Favored For Puerto Rico Route

Washington—Pan American World Airways has been recommended to provide service between Boston, Philadelphia, Baltimore and Washington and San Juan, Puerto Rico in addition to its current authority to fly from New York to San Juan.

The recommendation was made to the Civil Aeronautics Board by Chief Examiner Francis W. Brown. In doing so, he overruled an earlier recommendation by Bureau Counsel Harry M. Shooman that Capital Airlines be certificated for the Philadelphia, Baltimore, Washington-San Juan route (AW Mar. 11, p. 41).

Brown said the ability of Capital to provide through service on presently existing flights would present a serious operational problem because of the inability of the Vickers Viscount turboprop transport to make the long flight to San Juan.

Modifying Pan American's existing New York-San Juan authority to include Boston, Philadelphia, Baltimore and Washington as co-terminals, Brown said, would enable the carrier to provide improved service to Puerto Rico.

Other recommendations by the examiner included:

- **That Eastern Airlines** be granted a permanent certificate between New York-Newark and San Juan.
- **That Trans Caribbean Airways, Inc.,** be granted a temporary certificate between New York-Newark and San Juan as the third carrier in the market.
- **That Miami be redesignated** as an intermediate point on Eastern's route between Chicago and Miami and that Miami be redesignated as an intermediate point between Eastern's New York-Miami route.
- **That Riddle Airlines** be granted a certificate to transport cargo between New York-Newark and San Juan for a temporary period and that Riddle Airlines be authorized to carry mail on a nonsubsidy basis over its certificated route.

American Cancellation Blamed on Slowdown

New York—American Airlines attributed cancellation of a number of flights scheduled out of LaGuardia airport over the weekend of April 26/28 and early last week to maintenance labor difficulties. Airline said members of Local 501, Air Transport Division, Transport Workers Union at LaGuardia carried out a slowdown, accompanied by picketing, which made the cancellations necessary.

Issue is assignment of additional maintenance people to late shift duty, a move scheduled to become effective starting last Saturday. American wants to change the men over to the later shift to accommodate the increasing demand for daytime flights, which makes night maintenance scheduling most advantageous in utilizing airplanes.

About 110 periodic maintenance workers now are assigned to the 11:45 p.m. shift, according to the airline, and some 25 of these men volunteer for the shift, which pays 14-16 cents more per hour than daytime work. Transfer would bring the total to about 150. Mechanics also work on an afternoon and a morning shift, and practice has been to rotate the men with a month spent on each shift. Under the new plan, rotation would involve five-month periods with three months spent on the night side.

The airline says it is perfectly within its rights to shift the men under a contract which runs until September, 1958. American was concerned that pickets, which appeared at the airline's Manhattan offices as well as at LaGuardia, were implying that flight safety was involved in the dispute because of the mechanics' health.

Union made no effort to negotiate, American said, and presented no formal grievance. Alleged slowdown apparently had slacked off by last Wednesday and flight schedules were back to normal.

The union denied that any slowdown order was in effect.

New Team Ends HAL Profit Drought

Honolulu—When Hawaiian Airlines recently reported a net profit for 1956 of $77,187, the surge of satisfaction around the office was something more than this modest return on a $5 million operation would seem to warrant.

But the reason wasn't hard to find. In 1955, Hawaiian lost $243,147 and in 1954 the loss was a crippling $592,038.

The return to the black was a welcome development for the 28-year old line that had been a steady moneymaker until it got a scheduled competitor (Trans-Pacific Airline) on its routes connecting the Hawaiian Islands in 1949. Returns have been uncertain since.

It also was a feather in the cap of the young, new management team headed by 38-year-old Arthur D. Lewis that moved to the helm of the company in 1955 when Stanley C. Kennedy, head of the airline since it was founded in 1929, moved up to be chairman of the board.

The reverses that threw HAL into such deep trouble in 1954 were highlighted by a sharp reduction in expected CAB mail pay and heavy depreciation costs on the five Convair 340s bought in 1952-53.

CAB contended the Convair was unsuited for the short haul (maximum flight 216 mi.) operations in the Territory, said Hawaiian should have stuck with the DC-3s still used by its competitor, TPA.

Fare Increase

This week, its operations solidly in the black and pointed upward, Hawaiian was still flying the Convairs and was off subsidy entirely, thanks to a 10% fare increase effective April 1 and substantial cost improvements brought about in the last two years.

Lewis, who moved the president's office from downtown Honolulu to Honolulu International Airport, sat at his clean-topped desk this week and used a slide rule to help explain how Hawaiian pulled itself out of the red.

A few comparisons between 1954 and 1956 helped tell the story. In that interval:

- **Number of employes** engaged in airline operations decreased 3%.
- **Plane-miles** flown decreased 5%.
- **But passenger-miles** climbed 16%.
- **Revenue ton-miles** climbed 9%.
- **And cash costs** of running the airline had stayed almost even despite significant salary and wage increases to all personnel during that interval.

Operating cost per revenue ton-mile, Lewis noted happily, had dropped from 89.4 cents to 77.7 cents in the two-year interval, while the costs of Hawaiian's competitor, TPA, had risen slightly from 98.9 cents to 99.7 cents.

For mainland U.S. local service carriers, the average operating cost per revenue ton-mile carried was $1.098 in 1954 and 99 cents in 1956.

Lewis, who came to Hawaiian in 1955 from American Airlines, used his instincts as much as any particular pattern in trying to boost income.

For example, McKinsey and Company, management consultants, had recommended staying out of contract maintenance operations and against increasing aircraft seating capacity.

Boosted Load

But when HAL boosted Convair seats from 44 to 50 and DC-3 seats from 24 to 31, it also boosted its average load per plane by three passengers.

And the maintenance service contracted for planes at Hickam Air Force Base, which adjoins Honolulu Airport, now employs exactly as many persons (92) as are employed in maintaining HAL's own planes.

It is a lucrative operation, Lewis says, though it is becoming increasingly competitive as other firms move into the field to bid for maintenance contracts.

These divergences from recommended policy are not to imply, though, that Lewis didn't value the management consulting recommendations presented to him as he moved into the firm.

They spotlighted problem areas and made it possible to move much more directly toward corrective action.

One of the early steps was a bookkeeping one.

The Convairs were re-financed and depreciated over 10 years instead of seven, with that step alone contributing $175,000 to the $730,000 operating profit improvement shown in the two-year period.

But the others dug into the operations, sales, maintenance and personnel problems.

Despite increasing passenger loads, the airline disposed of one cargo DC-3 and one passenger DC-3 in 1955 and leased a Convair to an Australian operator for a few months during the winter slow period in Hawaii operations.

It removed carry-on baggage racks in its five Convair 340s to provide six extra seats (total 50), and found the extra passenger revenue more than offset the added baggage handling cost.

Beside boosting its DC-3 seats from 24 to 31, it put 5 ft. long panoramic windows in four of its six DC-3s as an added attraction to travelers.

In a move undertaken only this year and not reflected in 1956 figures, it has cut DC-3 operating costs an esti-

Hawaiian Airlines 1954-1956 Comparison

	1954	1956	Change
Employes in Airline Operations	501	487	off 3%
Employes in Contract Maintenance	3	24	up 700%
Revenue Plane-Miles	3,135,356	2,954,608	off 5½%
Passengers Carried	387,887	428,286	up 11%
Per Cent of Passenger-Miles in Inter-Island Service	70.4%	69.5%	off 1%
Passenger-Miles	51,548,856	59,987,597	up 16%
Payload Factor (Percent of Passenger Plane Weight Capacity Used)	47.59%	53.96%	up 13%
Passenger Revenue	$3,712,836	$4,223,833	up 14%
Cargo Lb. Carried	21,293,699	18,919,973	off 11%
Payload Factor (Percent of DC-3 Freighter Capacity Used)	57.77%	61.28%	up 6%
Cargo Revenue	$667,022	$705,769	up 6%
Federal Subsidy	$284,449	$237,768	off 17%
Net Income (or Loss) Before Special Items	$652,315 loss	$77,187 profit	
Net Income (or Loss) After Sale of Aircraft and Refund of U. S. Taxes	$592,038 loss	$77,187 profit	

Progress with **TITANIUM**

HEAT TREATED TITANIUM

...helps the Hustler spread its wings

The Plane: The U.S. Air Force's delta-winged B-58 Hustler, made by Convair—Fort Worth. To achieve supersonic speeds, designers had to make optimum use of all materials, considering strength, weight, high temperature performance.

The Improvement: 6Al-4V titanium alloy, furnished by Mallory-Sharon, was used in certain applications as a direct substitution for steel for wing fittings bearing heavy loads. This alloy, weighing 44% less than steel, has equal or superior strength for the heat-treated conditions.

The Service Need: The Hustler is the first major application of a new technique that extends titanium usefulness—heat treating. The alloy material is supplied in a medium strength level which permits ease of rough machining. Then the part is heat treated and finished machined to the high strengths desired in service.

To help in this development, Mallory-Sharon service engineers recommended and assisted Convair in establishing qualified subcontractor sources. We furnished bar stock to these companies for evaluation, recommended furnace type, conditions, temperatures, and heating times. We performed mechanical and chemical tests before and after heat treatment, to guide this phase of the program to a successful conclusion.

The Result: Improved performance; America's first supersonic bomber. Use Mallory-Sharon's outstanding technical service on *your* applications of this new metal. For information, write Dept. B-5.

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Producers of titanium and titanium alloy sheet, strip, plate, rod, bar, billets

mated 10% by using maximizer kits to increase speed by 20 mph with no increase in horsepower, thus expects to travel 11% more miles in any given number of flight hours.

Scheduled extra sections (e.g., on weekends) were eliminated and these were booked only when business warranted.

When accounting studies showed that freight operations were being conducted at a loss, higher freight rates were established. The net result, though the CAB has rolled back part of the increase, was less freight and more freight revenue, with the all-freighter fleet reduced from three DC-3 cargo planes to two.

Hawaiian got 20.9% of its revenue ton-miles from freight in 1956, a higher percentage than any other U.S. carrier operating both passenger and cargo services. Revenue-wise, however, freight produced only 13.9% of its operating revenues, a figure it has used in justification of its bid for higher freight rates.

Sales promotion and traffic handling activities were consolidated in one department with all traffic-handling subject to the discipline of the sales department—"recognizing that a satisfied user is your most effective sales agent."

The integration, Lewis feels, reduced a tendency toward conflict between the two activities. This had developed at one station to the point that the sales and traffic managers hardly spoke to each other.

Sales solicitation was divided so that promotion among tourist sources and among local island residents were handled separately in recognition of significantly different sales techniques required to reach the two groups. Local trade produces about two-thirds of the sales volume, tourist one-third.

Efforts to attain warmer, more attractive service led to such steps as employing an ex-stewardess to be at the terminal to assist elderly persons, mothers with children, etc.; relaxation of a no smoking ban that used to apply at all times in flight; extension of hours for receiving reservations; establishment of an honor award for stewardesses commended by passengers.

All jobs in the company were restudied and a complete reorganization attained, with a number of changes in executive personnel.

The purchasing and stores departments were consolidated.

An office of economic control and a modern budget system were installed, with every operation of the company placed on a detailed budget and effective follow-up procedures established.

A production control group was set up in the maintenance department and began establishing standards relating to man-hour efficiency.

A number of supervisor jobs were eliminated in order to prevent duplication and overlap.

Contract maintenance operations were aggressively sought from Hickam Air Force Base with contracts obtained for overhaul and repair of accessories, cowling, and certain aircraft, and for towing and positioning aircraft at Hickam.

Where Hawaiian formerly had no one working in this field, it has 92 employes in contract maintenance now versus an average of 24 in 1956 and the work volume is still increasing.

Lewis gives much of the credit for Hawaiian's changed outlook to what he calls the "lean and hungry" young executives gathered around him.

The roster includes: Jack C. Tobin, vice president for sales and service; Brian A. Cooke, vice president and treasurer; and Lionel D. Machado, vice president for operations. All three moved into their present jobs after Lewis took over with Tobin coming over from United Air Lines.

Executive Salaries for 1956 Reported by Airlines to CAB

Reports of officers' and directors' salaries for calendar year 1956 as filed with the Civil Aeronautics Board for the following airlines are:

Eastern Air Lines

E. V. Rickenbacker, chairman of the board, general manager and director, $50,000 salary, $800 bonus and indirect compensation; **T. F. Armstrong,** president and director, $35,000 salary, $5,703 bonus and indirect compensation; **P. F. Brattain,** first vice president and director, $32,500 salary, $7,854 bonus and indirect compensation; **S. L. Shannon,** senior vice president and director, $30,000 salary, $5,419 bonus and indirect compensation; **G. A. Smith,** second vice president, $20,000 salary.

T. E. Creighton, treasurer and director, $17,500 salary, $2,145 bonus and indirect compensation; **L. P. Arnold,** vice president and director, $22,500 salary, $4,144 bonus and indirect compensation; **M. M. Frost,** vice president, $27,500 salary, $3,549 bonus and indirect compensation; **W. L. Morrisette, Jr.,** vice president, $17,500 salary, $1,179 bonus and indirect compensation; **W. Van Dusen,** vice president, $20,000 salary, $2,244 bonus and indirect compensation;

C. Froesch, vice president, $17,083 salary, $3,107 bonus and indirect compensation; **J. H. Brock,** vice president, $20,000 salary, $2,725 bonus and indirect compensation; **R. Ramspeck,** vice president, $20,000 salary; **B. T. Dykes,** vice president, $17,267 salary, $3,334 bonus and indirect compensation; **F. T. Farley,** secretary, $13,981 salary, $1,521 bonus and indirect compensation; **J. K. Kilcarr,** assistant treasurer, $12,000 salary, $749 bonus and indirect compensation; **J. C. Warlick,** assistant secretary, $16,000 salary, $942 bonus and indirect compensation; **R. S. Lipp,** assistant secretary, $4,355 salary, $227 bonus and indirect compensation.

F. R. Cook, director, $200 bonus and indirect compensation; **P. M. Dums,** director, $400 bonus and indirect compensation; **G. B. Howell,** director, $300 bonus and indirect compensation; **H. Knowlton,** director, $400 bonus and indirect compensation; **S. Penbody, Jr.,** director, $400 bonus and indirect compensation; **R. E. Reinhold,** director, $500 bonus and indirect compensation; **L. S. Rockefeller,** director, $600 bonus and indirect compensation; **McGregor Smith,** director, $500 bonus and indirect compensation; **W. L. Moore,** director, $800 bonus and indirect compensation.

Northeast Airlines

G. E. Gardner, president and director, $25,000 salary, $5,000 bonus and indirect compensation; **A. A. Lane,** vice president-operations, $15,000 salary, $1,500 bonus and indirect compensation; **R. P. Turner,** vice president-sales, $10,600 salary, $2,000 bonus and indirect compensation; **D. W. H. MacKinnon,** vice president-engineering and maintenance, $12,000 salary, $1,500 bonus and indirect compensation; **Hamilton Heard,** treasurer, $15,000 salary, $1,500 bonus and indirect compensation; **G. E. Reed,** assistant treasurer, $8,750 salary, $250 bonus and indirect compensation.

Northwest Airlines

D. W. Nyrop, president, chief executive officer and director, $52,000 salary; **M. S. Mackay,** executive vice president and director, $30,000 salary; **F. C. Judd,** vice president-engineering and operations, $25,000 salary; **G. M. Bain,** vice president-sales, $20,833 salary; **L. C. Glotzbach,** vice president-personnel, $23,000 salary; **A. E. Floan,** vice president, secretary and director, $22,000 salary; **L. S. Holstad,** comptroller, $20,000 salary, **W. J. Eiden,** treasurer, $20,000 salary; **A. D. Piepgras,** assistant comptroller, $12,000 salary.

D. H. Hardesty, assistant treasurer, $12,000 salary; **F. J. Scott,** assistant secretary, $9,600 salary; **D. Merrick,** assistant vice president-properties, $13,000 salary; **C. L. Stewart,** assistant vice president-plans $15,000 salary; **P. L. Benscoter,** vice president-Orient region, $15,000 salary; **P. T. Drotning,** (employed on Nov. 5, 1956) vice president-public relations, $2,500 salary; **J. W. Mariner,** vice president-sales, $11,269 salary; **Croll Hunter,** chairman of the board, $50,000 salary; **J. H. Binger,** director, $800 salary.

M. H. Fry, director, $1,000 salary; **R. M. Hardy,** director, $300 salary; **J. T. Johnson,** director, $900 salary; **Alonzo Pettys,** director, $900 salary; **C. F. Reavis,** director, $400 salary; **A. G. Redpath,** director, $1,100 salary; **William Stern,** director, $1,600 salary; **L. E. Wakefield, Jr.,** director, $900 salary; **A. J. Weatherhead, Jr.,** director, $600 salary; **Wheelock Whitney,** director, $700 salary.

Trans World Airlines

R. S. Damon, president and director, (deceased on Jan. 4, 1956), $11,318 salary, $16,276 bonus and indirect compensation; **W. L. Pierson,** chairman of the board of directors, $66,101 salary, $23,730 bonus and indirect compensation; **J. A. Collins,** executive vice president and director, $65,492 salary, $20,855 bonus and indirect compensation; **E. O. Cocke,** senior vice president-sales and director, $36,200 salary, $13,242 bonus and indirect compensation; **A. V. Leslie,** senior vice president-finance, treasurer and director, $36,200 salary, $9,479 bonus and indirect compensation; **G. H. Clay,** vice president, secretary and director, $24,800 salary, $7,173 bonus and indirect compensation; **F. G. Betts,** vice president-purchasing, $16,025 salary, $2,913 bonus and indirect compensation.

J. H. Clemson, vice president-passenger service, $25,000 salary, $4,702 bonus and indirect compensation; **F. E. Busch,** vice president-operations, $21,732 salary, $4,698 bonus and indirect compensation; **P. G. Desautels,** vice president-overseas, $16,795 salary, $1,232 bonus and indirect compensation; **R. M. Dunn,** vice president-overhaul and maintenance, $16,442 salary, $1,442 bonus and indirect compensation; **C. S. Fullerton,** vice president and general sales manager, $18,776 salary, $2,194 bonus and

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indirect compensation; **G. L. Gilmore**, vice president-public relations, $20,000 salary, $5,236 bonus and indirect compensation; **D. W. Harris**, vice president-industrial relations, $15,185 salary, $4,494 bonus and indirect compensation; **J. W. Letzkus**, vice president-regional sales, $20,010 salary, $1,861 bonus and indirect compensation.

L. P. Marchal, vice president-regional sales, $13,337 salary, $1,172 bonus and indirect compensation; **R. Mazzarrini**, vice president-regional sales, $16,904 salary, $1,262 bonus and indirect compensation; **C. E. McCollum**, vice president-regional sales, $14,804 salary, $3,451 bonus and indirect compensation; **R. E. Montgomery**, vice president-regional sales, $15,585 salary, $1,725 bonus and indirect compensation; **R. W. Rummel**, vice president-engineering, $15,210 salary, $1,076 bonus and indirect compensation.

A. L. Stewart, vice president-regional sales, $15,172 salary, $97 bonus and indirect compensation; **T. K. Taylor**, vice president, $24,000 salary, $5,778 bonus and indirect compensation; **J. W. Thomas**, vice president, $14,284 salary, $1,048 bonus and indirect compensation; **J. L. Weller**, vice president-planning and coordination, $22,000 salary, $5,609 bonus and indirect compensation; **F. W. Ayers**, director, $600 salary, $140 bonus and indirect compensation; **J. E. Bierwortt**, director, $10 bonus and indirect compensation; **P. Bradley**, director, $1,200 salary, $140 bonus and indirect compensation.

P. Crosley, Jr., director, $100 salary, $44 bonus and indirect compensation; **N. Dietrich**, director, $800 salary, $140 bonus and indirect compensation; **A. Eisenhower**, director, $800 salary, $140 bonus and indirect compensation; **O. Holcombe**, director, $1,000 salary, $140 bonus and indirect compensation.

S. Maestre, director, $1,100 salary, $140 bonus and indirect compensation; **D. J. Martin**, director, $400 salary, $96 bonus and indirect compensation; **M. E. Montrose**, director, $700 salary, $140 bonus and indirect compensation; **C. H. Price**, director, $500 salary, $96 bonus and indirect compensation.

H. E. Rogers, director, $1,100 salary, $140 bonus and indirect compensation; **B. F. Sessel**, director, $1,000 salary, $140 bonus and indirect compensation; **A. D. Simpson**, director, $1,100 salary, $140 bonus and indirect compensation; **T. A. Slack**, director, $600 salary, $140 bonus and indirect compensation; **L. Wright**, director, $700 salary, $140 bonus and indirect compensation.

United Air Lines

W. A. Patterson, president, $100,000 salary; **R. E. Johnson**, assistant to the president and vice president, $50,000 salary; **J. A. Herlihy**, vice president-engineering and maintenance, $50,000 salary; **D. F. Magarrell**, vice president-transportation services, $50,000 salary; **D. R. Petty**, vice president-flight operations, $45,000 salary; **C. Barkes**, vice president-finance and property, $40,000 salary; **R. F. Aherns**, vice president-personnel, $35,000 salary; **H. E. Nourse**, vice president-economic controls, $30,000 salary; **R. W. Ireland**, vice president-traffic administration, $27,000 salary; **C. F. McErlean**, vice president and assistant to the president, $27,500 salary; **S. P. Martin**, secretary-corporation and assistant to the president, $18,000 salary; **R. E. Bruno**, comptroller, $19,000 salary; **A. M. de Voursney**, treasurer and assistant secretary, $20,000 salary.

M. C. Ansorge, director, $3,000 salary; **P. A. Bissinger**, director, $2,750 salary; **H. T. Brown**, director, $3,000 salary; **G. Cowles**, director, $2,250 salary; **J. W. Dart**, director, $2,250 salary; **T. F. Gleed**, director, $3,000 salary; **P. G. Hoffman**, director, $2,500 salary; **E. A. Johnston**, director, $2,500 salary; **J. J. Mitchell**, director, $2,500 salary; **A. Nielson**, director, $2,750 salary; **V. Stauffer**, director, $2,750 salary.

Western Air Lines

T. C. Drinkwater, president and director, $60,700 salary; **S. R. Shatto**, vice president-operations and director, $33,700 salary; **M. W. Landes**, vice president-service and director, $28,200 salary; **P. E. Sullivan**, vice president-administration and secretary, $27,500 salary; **A. F. Kelly**, vice president-sales, $27,500 salary; **J. J. Taylor**, vice president and treasurer, $27,500 salary; **D. P. Renda**, vice president-legal, $27,500 salary; **C. Brooder**, vice president, $20,000 salary; **C. J. J. Cox**, controller and assistant treasurer, $20,000 salary; **E. H. Brown**, assistant secretary and director of personnel, $13,000 salary.

W. S. Bartman, director, $400 salary; **G. Y. Billard**, director, $400 salary; **H. W. Darling**, director, $700 salary; **R. E. Driscoll**, director, $700 salary; **H. C. Haight**, director, $700 salary; **D. H. McLaughlin**, director, $700 salary; **L. W. Pogue**, director, $400 salary; **J. F. Ringland**, director, $700 salary.

H. J. Volk, director, $700 salary; **J. M. Wallace**, director, $400 salary; **A. Warden**, director, $700 salary; **S. F. Woodbury**, director, $500 salary.

Lufthansa Convairs

Two new Convair 440s en route to Germany for Lufthansa European service are shown at New York International Airport. Planes were flown by the airline from San Diego via Kansas City, New York, Goose Bay and Keflavik.

Pan American World Airways

J. T. Trippe, president and director, $20,000 salary, $2,050 bonus and indirect compensation; **D. C. Leslie**, vice president and director, $33,000 salary, $21,000 bonus and indirect compensation; **H. J. Friendly**, vice president, general counsel and director, $33,000 salary, $20,700 bonus and indirect compensation; **S. F. Pryor**, vice president, assistant to the president and director, $31,000 salary, $17,450 bonus and indirect compensation; **F. Gledhill**, vice president and director, $32,000 salary, $20,000 indirect compensation; **H. E. Gray**, executive vice president-Atlantic division, $33,000 salary, $20,000 bonus and indirect compensation; **W. L. Morrison**, executive vice president-Latin American Division, $33,000, $20,000 bonus and indirect compensation; **W. G. Lipscomb**, vice president-traffic and sales, $32,000 salary, $19,000 bonus and indirect compensation.

A. P. Adams, vice president, $28,000 salary, $10,000 bonus and indirect compensation; **E. Ballunder**, vice president, $28,000 salary, $12,000 bonus and indirect compensation; **C. M. Young**, executive vice president-Pacific Division, $28,000, $12,000 bonus and indirect compensation; **H. H. Berke**, vice president, $24,000 salary, $10,000 bonus and indirect compensation; **R. B. Adams**, vice president, $25,000 salary, $8,000 bonus and indirect compensation; **H. W. Toomey**, vice president, $20,000 salary, $2,500 bonus and indirect compensation.

R. Lewis, executive vice president-development and defense projects, $28,000 salary, $20,000 bonus and indirect compensation; **R. B. Murray**, vice president, $20,100 salary, $7,000 bonus and indirect compensation; **A. J. Kelly**, vice president, $8,000 salary, $3,000 bonus and indirect compensation; **E. M. Goulard**, vice president, $17,500 salary, $5,000 bonus and indirect compensation; **R. S. Mitchell**, vice president-Guided Missiles Range Division, $20,000 salary, $7,000 bonus and indirect compensation; **J. S. Woodbridge**, comptroller, $24,000 salary, $11,000 bonus and indirect compensation; **R. G. Ferguson**, treasurer, $24,000 salary, $10,000 bonus and indirect compensation; **H. P. Morris**, secretary and general counsel, $14,000 salary, $3,500 bonus and indirect compensation.

W. W. Lynch, assistant vice president, $20,100 salary, $4,500 bonus and indirect compensation; **S. B. Kauffman**, assistant vice president, $18,000 salary, $6,500 bonus and indirect compensation; **J. C. Cone**, assistant vice president, $16,000 salary, $6,000 bonus and indirect compensation; **W. J. McEvoy**, assistant vice president, $13,000 salary, $3,000 bonus and indirect compensation; **R. P. Monson**, assistant treasurer, $16,000 salary, $7,000 bonus and indirect compensation; **J. E. McGuire**, assistant comptroller, $13,000 salary, $3,0[illegible] bonus and indirect compensation; **E. G. Rothrock**, assistant secretary, $12,000 salary, $1,250 bonus and indirect compensation; **J. Macy, Jr.**, assistant secretary, $12,400 salary, $250 bonus and indirect compensation; **J. J. Cantwell**, assistant secretary, $9,400 salary, $750 bonus and indirect compensation.

S. M. Fairchild, director, $1,000 bonus and indirect compensation; **H. M. Bixby**, director, $5,000 bonus and indirect compensation; **R. V. Fleming**, director, $1,100 bonus and indirect compensation; **M. Griswold**, director, $1,500 bonus and indirect compensation; **R. J. Hamill**, director, $1,300 bonus and indirect compensation; **R. W. Howard**, director, $1,400 bonus and indirect compensation; **D. S. Ingalls**, director, $1,600 bonus and indirect compensation.

R. Lehman, director, $1,000 bonus and indirect compensation; **E. O. McDonnell**, director, $5,000 bonus and indirect compensation.

M. T. McKee, director, $5,000 bonus and indirect compensation; **J. S. Rockefeller**, director, $1,100 bonus and indirect compensation; **W. H. Standley**, director, $900 bonus and indirect compensation.

Cordova Airlines

M. K. Smith, president and director, $19,000 salary; **D. Swanson**, vice president-operations, $10,350 salary; **B. C. Smith**, secretary-treasurer, $6,450 salary.

Flying Tiger Lines

S. B. Mosher, chairman of the board of directors, $500 salary; **R. W. Prescott**, president and director, $42,000 salary; **W. E. Bartling**, vice president-research and development, $14,400 salary; **F. Benninger**, executive vice president and treasurer, $25,500 salary; **O. R. Burghardt**, secretary and assistant treasurer, $15,400 salary; **L. C. Burwell, Jr.**, vice president, $18,000 salary; **A. T. Chase**, director, $300 salary; **J. C. Cosgrove**, director, $300 salary; **G. T. Cos-**

Now, the long-awaited aircraft loran, designed primarily to fill the needs of transoceanic flying and packaged for cockpit installation, is announced by EDO. Built specifically to meet airline requirements, this new lightweight unit is designed for instrument panel mounting, convenient to the pilot.

It's no longer necessary to pay a heavy weight penalty for the added safety and convenience of loran gear. Edo's new set weighs only 26 pounds completely installed.

Built to the highest electronic standards, the Edo Model 345 gives quick, directly read time difference readings for accurate plots in a matter of seconds. No calculation, no computations, no tables, no special training needed to operate. As simple to use as any other pilot-operated radio navigation aid.

A development of Edo's years of research, design and production of dependable marine loran sets and other high performance electronic equipment, the Model 345 contains the latest miniaturized circuitry. Its compact remote control console and clear, easily read 3-inch scope fit neatly into the restricted space of an airplane instrument panel.

If you are interested in detailed specifications and operating data, please write for particulars.

Model 345

For Cockpit Installation

26 Pounds Total Weight

Compact scope and command control designed for cockpit installation. 34-tube receiver (not shown) occupies ¾ ATR rack.

FEATURES OF THE EDO MODEL 345

- **3-inch scope easily read even under bright light conditions. Does not require a special hood. Can be mounted directly in instrument panel, or other accessible spot.**
- **Pilot-operated command control gives directly read solution to problem. No calculations, no tables, no special training needed to operate.**
- **Loran receiver containing 34 tubes. Features low power consumption — only 175 watts, 115 v 400 cycles; 25 watts, 24 v DC.**
- **No-drift signal assured by special oscillator control.**
- **Highly accurate voltage regulation for dependable operation.**
- **Complete fail-safe feature.**

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Manufacturers of

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a Trusted Line of Marine and Airborne Electronic Equipment

sen, vice president, $15,683 salary; **J. E. Davidson**, director, $500 salary; **J. L. Higgins**, assistant vice president, $14,065 salary; **L. S. Kimball**, vice president, $19,350 salary; **F. B. Lynott**, vice president, $18,500 salary; **G. M. Messenger**, vice president, $12,000 salary; **N. L. Meyers**, assistant secretary, a member of Meyers and Batzell which was paid $42,000 for legal services in 1956; **Houston Rehrig**, director, $400 salary; **R. B. Stump**, assistant secretary, $10,688 salary.

Alaska Coastal Airlines

Alaska Coastal Airlines is a partnership. No salaries were reported.

Allegheny Airlines

L. O. Barnes, president and director, $25,000 salary; **E. K. Arnold**, vice president and secretary, $11,200 salary; **D. L. Miller**, vice president-traffic and sales, $11,200 salary; **W. L. Short**, vice president and treasurer, $12,500 salary.

Southwest Airways

J. H. Connelly, president and director, $24,883 salary; **T. R. Mitchell**, vice president, $15,921 salary; **A. W. Johnson**, vice president, treasurer and director, $16,635 salary; **R. Costello**, vice president and assistant secretary, $12,963 salary; **M. King**, vice president, $9,768 salary.

Unit Formed to Ease Gander Traffic Jam

New York—North Atlantic operators agreed last week to establish a traffic schedule coordination group at Gander in a voluntary effort to ease the traffic jam threatened by this summer's anticipated peak travel. The move is to forestall a threat by the Civil Aeronautics Administration and Canadian Department of Transport to impose flow control unless the airlines voluntarily work out improved traffic scheduling.

Under the new plan, North Atlantic carriers will file flight estimates by teletype several hours in advance of flight time, giving desired routes and altitudes. An air traffic coordinating group in Gander, consisting of airline dispatchers, traffic controllers and meteorological personnel, will analyze these flight estimates for potential conflicts in flight arrivals.

When such conflicts are discovered, the group will notify the carriers involved and also give their recommendations for resolving the conflict. However, the group will not have authority to order either operator to change his initial plans.

The coordination group is the result of studies by North Atlantic operators of their growing traffic control problems. These studies revealed, for instance, that 40% of the North Atlantic flights in the summer are forced to revise initial flight plans because of conflicts, after considerable effort has gone into planning optimum route and altitudes.

In some instances the conflicts are between two aircraft of the same operator.

AIRLINE OBSERVER

► Airlines have agreed upon a downtown site in Chicago for a proposed consolidated passenger terminal after considering 20 other locations during the past six months (AW Nov. 26, p. 45). A Chicago airlines' committee headed by United Airlines Vice President Curtis Barkes will begin negotiations with a group of business executives who have offered terminal space in a new building to be constructed on the proposed site on the western boundary of the Chicago Loop.

► Airlines also have agreed to accept interest payment and bond retirement on $80 million revenue bonds to be issued for the development of O'Hare International Airport in Chicago. Plans call for expenditures of funds by 1960 to permit transfer of most airline flights at that time from overcrowded Midway to O'Hare. Approximately $50 million will be used to add a second runway, to triple gate space and increase the size of the O'Hare terminal. Some $30 million will be used for airline hangar construction. An additional $15 million for airport improvement will be supplied by the city of Chicago for further airport improvement in a proposed bond issue to be submitted to voters at the June 3 judicial election.

► Sabena Belgian World Airlines has increased its Brussel-Paris helicopter service from two to five roundtrip flights daily except Sunday when only one flight is scheduled.

► United Airlines will eliminate time-worn flight kits on all flights this month. Kits will be replaced by a monthly, full-color, travel magazine the airline will publish for general passenger distribution. The magazine, which will feature general interest travel articles, sports, humor and airline progress stories, will be inserted in seat pockets together with flight strip maps. First edition will run approximately 100,000 copies, but the airline anticipates a substantial increase in volume in subsequent editions.

► Postmaster General Arthur Summerfield says the Post Office is increasing its dependence on airlines and trucks for mail delivery. Mail carrying trains have decreased from 10,000 to 2,600 during the past 25 years; today more than 70% of U. S. post offices cannot be reached directly by train.

► Trans World Airlines will seek contracts for the overhaul of military piston-engines at its Kansas City overhaul base. In a four-point cooperation program presented to Missouri civic leaders, TWA President Carter Burgess said the plan would increase utilization of the Kansas City base, increase local employment and free military maintenance personnel for jet and missile work. Burgess also asked for support in obtaining a 6% fare increase, a proposed new route from St. Louis to Miami and a closing of the Frankfurt-Zurich gap on its international route.

► Air Line Pilots Assn. has filed formal complaints with the Civil Aeronautics Board against American, Eastern, National and Trans World Airlines for publishing "unrealistic and impractical flight schedules." ALPA charged the four carriers with publishing schedules that "in many instances, are so erroneous, misleading and unrealistic as to constitute deceptive practice." The union added its studies indicated some flights failed to operate according to schedule "even once over a period of a month."

► American Airlines will expand its Tulsa overhaul base to handle maintenance and overhaul of its forthcoming fleets of 30 Boeing 707 turbojet transports and 35 Lockheed Electra turboprops. The Tulsa facility is American's principle overhaul base for aircraft, engines and accessories.

► National Airlines will begin Channel 10 TV service next month over its Miami WPST-TV public service television station. Planned telecasts have been moved ahead by three months as a result of National's purchase of land, tower studio facilities of WGBS-TV, UHF Channel 23 in Miami. These facilities will be used until the studios of WPST-TV are completed. Authority to begin construction of Channel 10 station was granted by the Federal Communications Commission on Feb. 8 to Public Service Television, Inc., a wholly-owned subsidiary of National Air lines.

TOWERS OF MANHATTAN form a backdrop for French Alouette helicopter (above) which Republic Aviation Corp. is licensed to manufacture in U.S. Republic brought two Alouettes (below) to U.S. for display at American Helicopter Society meeting in Washington this week. Top helicopter is equipped with flotation gear.

Alouette May

New York—Republic Aviation's version of the turbine-powered Alouette II appears to be a serious contender against Bell Helicopter's XH-40 for U. S. Army's utility helicopter requirement.

The French five-place helicopter, licensed by Sud Aviation for manufacture by Republic, was demonstrated recently here. Republic plans to increase power and make other changes to aid Alouette's performance which would enhance its competitive role.

Bell's turbine-powered XH-40, which carries six passengers, is undergoing Phase I flight testing at its Ft. Worth plant (AW March 18, p. 69). Second of three experimental flight test models and seven YH-40 service test models are on order.

Republic also appears interested in Navy competition, where Kaman HU2K-1 has a development contract (AW Feb. 11, p. 34).

Continental Licensed

The Alouette II is powered by a Turbomeca Artouste II fixed-turbine engine developing 360 hp. at takeoff with a continuous performance rating of 325 hp.

At 10,000 ft. gas turbine furnishes 270 hp. cruising under normal conditions. Continental Aviation and Engineering Corp. is licensed to manufacture the engine in the United States.

Plans are that Turbomeca will ship Artouste engines of approximately 400 hp. to Continental, which will then convert them to U.S. standards, change fittings, make other changes to bring engines up to 425 hp.

Continental then will ship the Americanized engines (Continental Model 220-2) to Republic for installation in its airframes. If demand warrants, Con-

UTILITARIAN layout is evident in cabin, which has bench type seat for passengers behind pilot. Interior is 52 in. wide and 82 in. long.

Compete With Bell XH-40

tinental will produce the 425 hp. engines for the Alouette.

Continental will establish a spares and engine overhaul shop similar to the one Rolls-Royce maintains for its Dart turboprop for Viscount buyers in Canada and the United States.

Additional Republic plans call for installing a 600 hp. Continental Model 219 (T51) in the Alouette to meet U. S. Army hot-day requirements for operation at 95F/6,000-ft. altitude conditions.

Continental is ready to tool for this powerplant.

Another Republic change calls for rotating present air inlets 90 degrees upward. Present Alouette IIs have inlets facing horizontally, which sends out a high-pitched compressor noise that can be annoying to people nearby. Facing vertically, the inlets would send noise skyward to be beaten down by rotor downwash and thus have noise reduced.

Alouette III

Sud Aviation now is building a prototype of Alouette III, a seven-passenger helicopter with a turbine of 100 additional horsepower. Company expects to have it in production by 1958.

It also has on the drawing boards several larger models, including a triple turbine-powered, 27-passenger type.

Current orders for the Alouette II total more than 130 for the French military services, with about 40 going to the French navy and the rest to the French army. Portugal is getting 2, Spain 3, Switzerland 3 and Germany 3. Some of the latter already have been delivered; all are believed to be for the military.

Other orders have been placed by Sweden and Venezuela.

Sud is negotiating contracts for about 50 Alouettes to be delivered to Brazil and Argentina.

Current Sud Alouette production includes two prototypes, three pre-production versions. Number 60 Alouette was rolled out recently and those demonstrated in New York were numbers 32 and 39 off the production line.

The present tour of the two helicopters is sponsored by Republic. It will hit commercial prospects as well as the military, and will visit Gulf Coast areas for demonstrations to off-shore oil companies and operators.

Pilots' Opinions

N. Y. Airways pilots who flew the Alouettes said they were much impressed by the helicopters' stability, low level of vibration, compared to piston-powered types' maneuverability and handling. The French pilots demonstrating the aircraft rocked the ships around in an amazing and hair-raising manner only a few feet off the ground in gusty weather. They flew close to bystanders and ground vehicles without mishap.

Alouette engineers claim there is a total of 5,000 hr. on the helicopters without a single case of engine failure.

Alouette II Specifications

Dimensions and weights:

Length	31 ft.-10 in.
Width	7 ft.-4½ in.
Height	9 ft.-1 in.
Empty weight	1,820 lb.
Useful load	1,480 lb.
Gross weight	3,300 lb.

Performance:

Cruising speed	110 mph.
Range	345 miles
Endurance	3 hr. 15 min.
Consumption	47 U. S. gal. per hr.
Maximum ceiling	over 26,000 ft.

Times between overhaul so far:

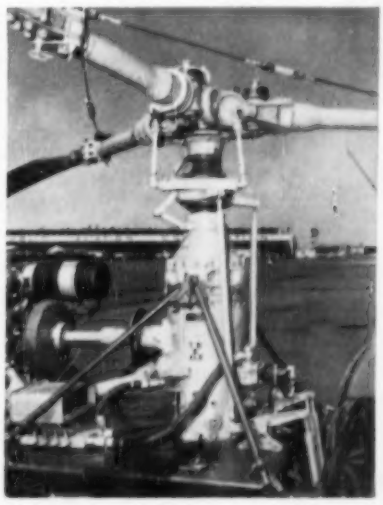
- **Artouste engine**—200 hr. Expect to go to 300 hr.
- **200 hr. for all** mechanical parts—gearbox, transmission, etc. About 800 hr. is on a gearbox now in a lab test run.
- **Rotor blade** life is now 300 hr.

Specific fuel consumption of the Artouste engine in the French-built Alouette II is .95, compared with the .65 sfc. of the Americanized 425-hp. version. Increased power will be procured without increasing weight, Continental says. The engine weight is about 245 lb. with accessories, 236 lb. dry.

Main rotor is of dural spar construction. Blade is hollow, space being filled with Multoprene, a foam plastic rammed into the blade under pressure. Blades are hermetically sealed to prevent leakage.

Single blades are not replaced; the

INLETS of Artouste engine would be rotated 90 deg. upward by Republic in U. S. version.



CABLE dampers hold 120 deg. blade separation. Pitch rods run from swash plate to hub.

TAIL ROTOR uses a conventional see-saw pitch control. Blades are hollow metal.

FACTS

about

NEW DEPARTURE BALL BEARINGS

New Departure split inner ring bearings are made in a range of sizes with and without inner ring puller grooves indicated in the exploded view above.

LOADS GET A LIFT with THIS BALL BEARING

Whether in helicopters or jet engines, New Departure ball bearings of split inner ring type provide very high load capacity. That's because the separable rings permit high race shoulders and a greater number of balls of large size.

These split inner ring *ball* bearings not only carry heavy thrust loads in either direction in addition to radial loads (with thrust predominant), but they have important application advantages.

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rotor blades being replaced a set at a time.

Replacing landing gear with skids reduces empty weight about 100 lb.

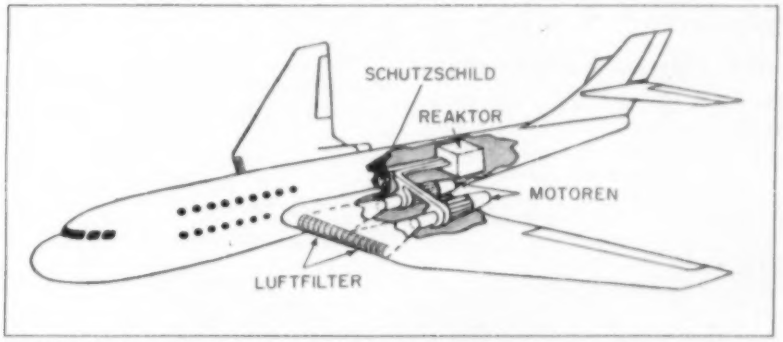
Cabin interior is 52 in. wide and 82 in. long.

To determine actual power ratings during life of engine between overhauls (normally engine power decreases as engine nears overhaul time), Continental has developed a simple, low-cost thermocouple probe to enable operator to check power output by measuring tail pipe temperatures.

Constant speed turbine of French-built Artouste operates continuously at 33,000 rpm. The main rotor rpm. remains constant at 349 rpm. It takes one minute for turbine to get up to 33,000 rpm., then copter is ready to take off.

Pilot controls are conventional cyclic and collective pitch levers. Engine speed governor with adjustable power limiter eliminates need for manual throttle-pitch coordination.

Price of American version Alouette has not yet been determined, but it is believed it will be approximately $70,000. Republic now is studying Sud Aviation's work sheets and sub-contractor costs to translate them into U. S. labor, material and handling costs.



SKETCH of Russian nuclear plane published in East Germany shows filter type inlet in leading edge (probably distorted) jet engines, piping to reactor in fuselage.

Soviets Report Atom Plane Work

Vienna—Soviet development of a nuclear powered aircraft apparently has passed the design stage for certain components and has reached the stage of construction of models and testing them on the ground and in the air.

A Russian engineer on the Tupolev design team, Yu. Sushkov, writing on nuclear aircraft progress for Communist young people, did not indicate whether the models were of an aircraft reactor or of airframe components.

However, he did add that first tests toward development of a nuclear powered aircraft were officially reported in December, 1955. These dealt with the effect of radiation on materials and the amount of shielding necessary.

Presumably these tests were Soviet tests, but Sushkov was ambiguous on this point.

The entire article could have dealt with U.S. development, with this fact carefully masked.

Prospective nuclear powerplant would utilize a turbojet type engine, the engineer said.

"Only the air charged through the compressors is not piped into the combustion chamber, but to the reactor," he said.

"The supercharged air passes through many small diameter horizontal holes of the reactor, where it is heated as in the combustion chamber of today's jet engines. . . ."

In a sketch of a proposed nuclear aircraft, reproduced in an East German newspaper which reached Vienna, the intakes were shown as filters or grids as an integral part of the wing leading edge and following its profile. The airflow then was shown piped into the reactor. No coolant was called for, as that used for heat transfer in shipboard propulsion units in U. S. Navy use.

Placing the passengers forward and the reactor in the rear is like placing the reactor in shade as far as shielding is concerned, Sushkov said. Passengers would wait in the cabin until remote control devices would remove the reactor and lower it into a well or pit.

Ordinary stationary reactors create temperatures of 330C, Sushkov said. Aviation reactors, to provide the necessary heat for propulsion, would have to create temperatures of 1,000C, he added, and this would require temperature resistant stainless steels. Such steels would create still more problems since they would slow down the speed of reaction considerably.

Use of a reactor to make steam which in turn would drive an aircraft propeller would be acceptable as a beginning, Sushkov said, but the ultimate goal of Soviet scientists is to build the smallest

M1238-1818 — *Range 18" x 18", working distance 9" to infinity. Reads to 0.001" up to 24" working distance. Protractor ocular reads to 3 minutes of arc. Image is erect.*

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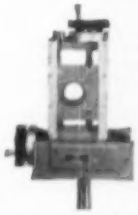
M1236-46— Horizontal range 6", vertical range 4". Reads to 0.0001", working distance 5" to infinity.



M1236-22— Range 2" x 2", reads to 0.0001". Working distance 5" to infinity. Shown with 19 mm mounting rod, and without telemicroscope. Instrument permits precise coordinate movement of other objects such as photo cells, probes, etc., in place of telemicroscope.

Write for Bulletin 188-53

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U. S. patent 2,769,265

possible reactor with the highest output of power.

The Soviets are looking forward to the advent of the thermo-nuclear reactor which would enable space flight.

As a comparison, Sushkov pointed out that the Tu-104 requires 150 metric tons of aviation gasoline to fly from Moscow to Vladivostok at 500 mph. where a nuclear aircraft would use but 70 to 75 grams of fuel for the same distance and speed.

Whether Sushkov was simplifying the subject considerably for younger readers, or whether the few technical details were based on actual Russian development was not indicated either.

Instrument Testing Tool Slows Vibrations

Seattle—Engineers in Boeing's Pilotless Aircraft Division have developed a tool to eliminate unwanted vibrations in testing instruments used in the Bomarc guided missile.

Instruments which direct and control Bomarc are tested and calibrated on vibration machines.

Shaking has to be restricted to the instrument being tested, and flight conditions simulated.

Engineers John R. Patten and Raymond D. Johnson used 5,000 lb. of concrete to aid in solving the problem. The concrete triangle, weighing 2½ tons, is suspended on six oppositely-wound coil springs inside a steel frame.

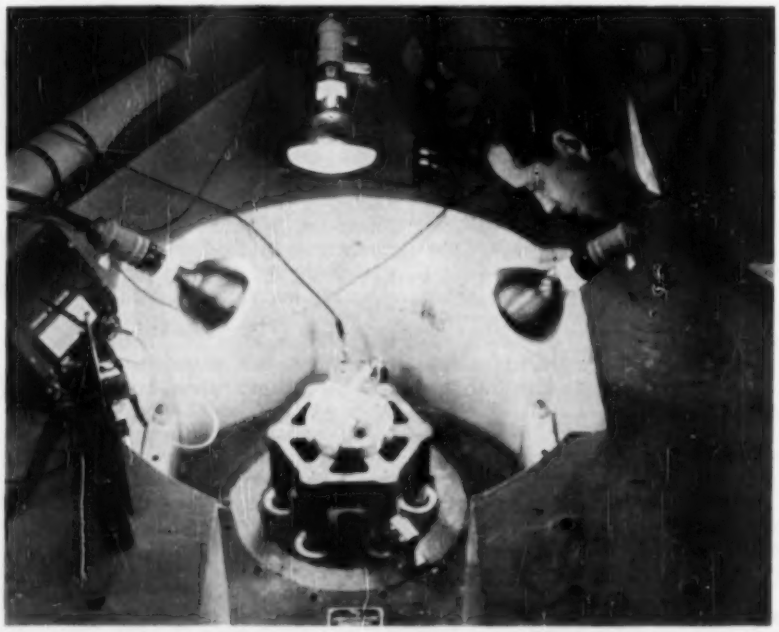
Vibrator is suspended in a large cup inside the concrete triangle. Depressed housing of the vibrator places it at a point which is both the center of suspension and gravity. Called "Seismic Mount for a Vibration Calibrator," the equipment virtually eliminates unwanted vibrations except those near and below 1¼ cycles per second. Vibrations varying from 2 to 2,000 cycles per second attaining a force 20 times that of gravity can be generated.

Martin TM-61C Matador Phased Into Squadrons

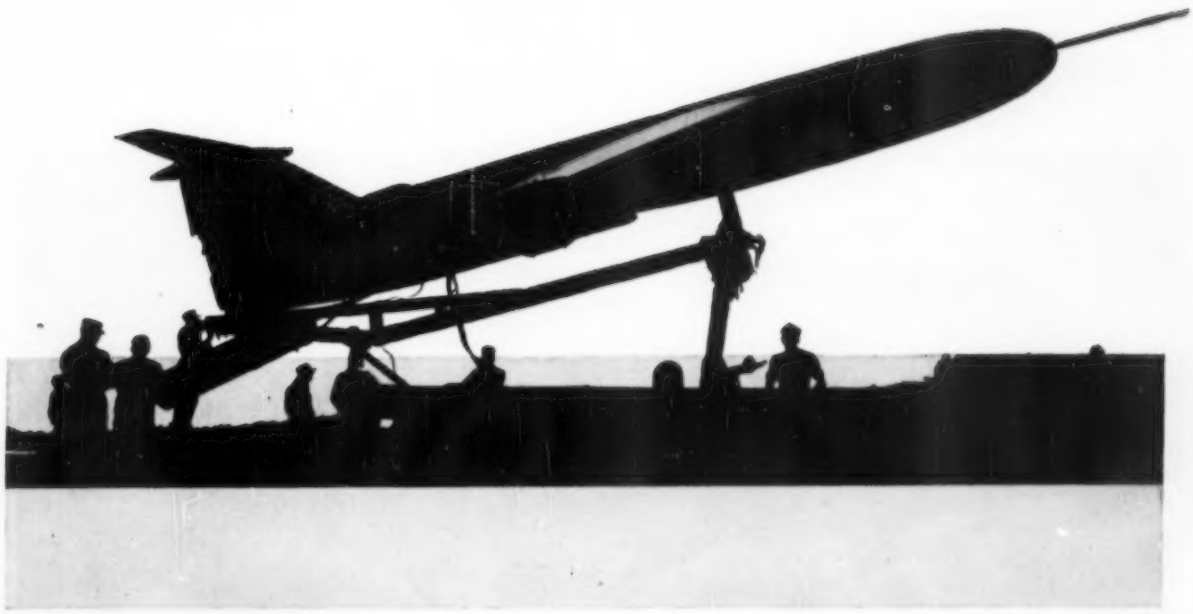
Martin TM-61C, new version of the Matador ground-to-ground tactical missile (AW Feb. 11, p. 32), is now being phased into operating squadrons by USAF. TM-61C probably incorporates an inertial guidance navigation system and has "substantially" longer range than earlier versions of the Matador. Martin says the navigation system has a "high resistance to electronic countermeasures" and provides for complete all-weather operation of the missile. Approximate cost: $60,000 per missile.

Titanium Demand Forecast To Decline, Rise Again

Decline in demand for titanium mill products by 1958 was predicted at meeting of NATO technologists by Dr. R. I. Jaffee, Battelle Memorial Institute technologist. Cause will be slackening of production of current jet engines, which use bulk of titanium production for compressors. However, by 1960 demand should increase again with production of advanced aircraft in Mach 2.5 and Mach 3 class, using high percentage of titanium.



BOMARC vibration simulator tests guidance control instruments for Boeing vehicle.

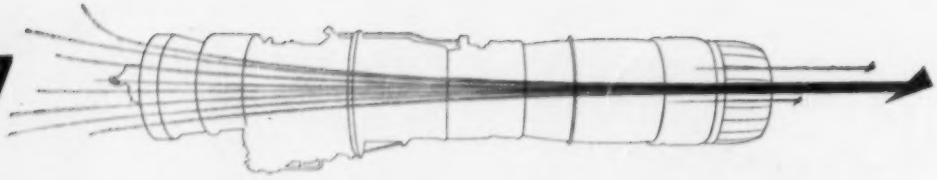


"PAPA" The Martin Matador TM61-B is the fourth generation of a famous family. As the lineal descendant of the first operational tactical missile in service with the Air Force—and the first pilotless bomber having complete interchangeability of parts—the performance, operability and advanced engineering of the Matador give it top rating in our missile arsenal. Today, this important weapon is one of five major Martin projects in the field of rockets and guided missiles that are under development or in production for the Army, Navy and the Air Force. It was the original Martin Matador, papa of them all, that launched the new age of missiles in America.

MARTIN

BALTIMORE DENVER ORLANDO

J57



The J57 is a big bruiser!

This turbojet engine weighs more than 5,000 pounds, develops more than 15,000 pounds of thrust, has thousands of parts—one of the smallest of which, a fuel nozzle seal, you see here.

But what do these figures really say about the J57 we build? Do they say it was designed by Pratt & Whitney, a division of United Aircraft Company?

. . . that it takes complete cooperation among the designer, Air Force, and manufacturer to make certain every engine meets rigid performance standards.

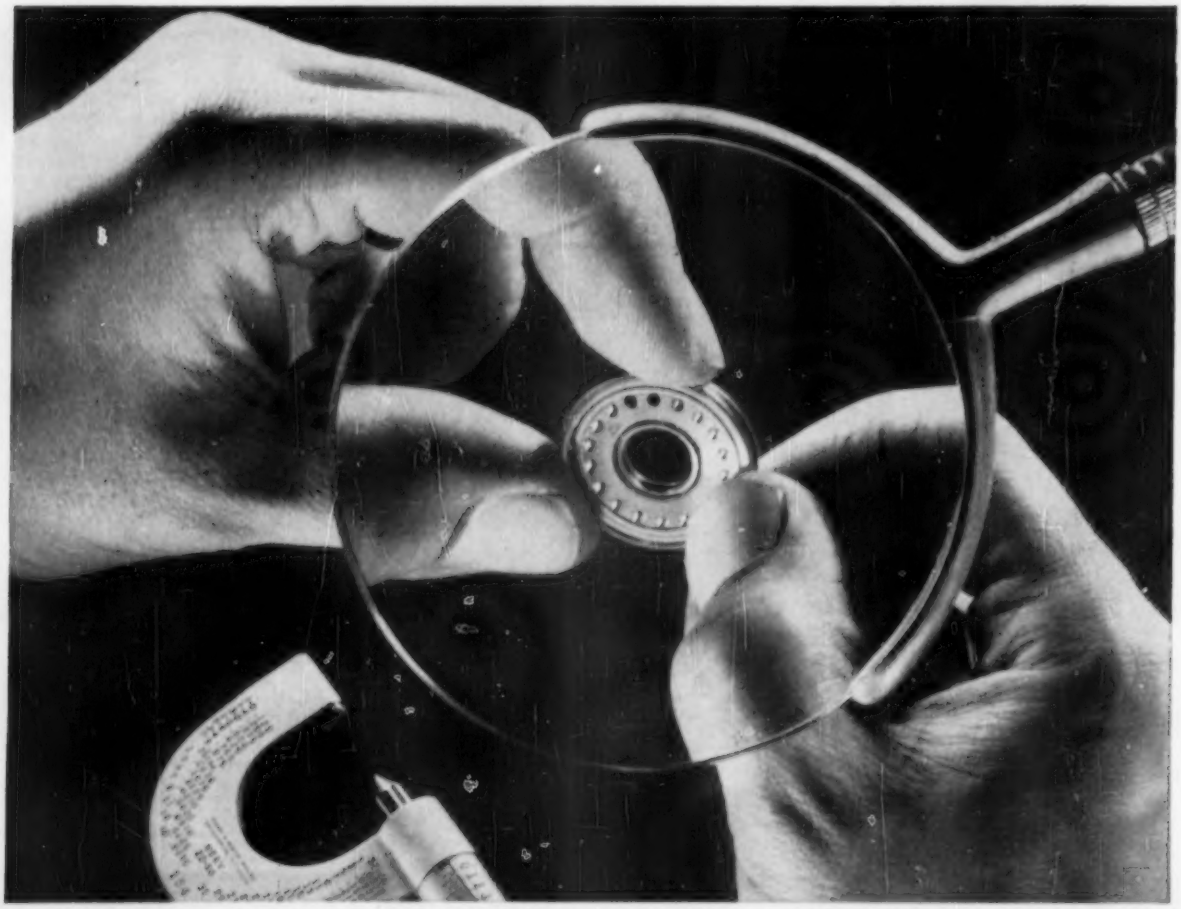
. . . that the J57 is used in some of the latest Air Force equipment: "century series" fighter models, B-52 intercontinental heavy bomber, and KC-135 tanker-transport.

. . . that it takes a vast network of parts suppliers reaching into 27 states to feed us the components we need to meet our schedules.

. . . that it takes teamwork *on every level* to establish and maintain quality volume production.

You can see cold statistics don't tell the full story. Unintentionally they miss this vital point: behind every completed engine lies a tremendous amount of cooperation and skill.

We believe the J57 jet engine is proof we've developed a high degree of both.



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Mountain Strips Limit Twin Pioneer

By David A. Anderton

Geneva—Swissair's three-month evaluation of the Scottish Aviation Twin Pioneer has shown it to be a versatile feederliner with exceptional short-field performance and one drawback: limited single-engine performance at mountain airstrips.

That failing is expected to eliminate the Twin Pioneer as a possible addition to the Swissair fleet, although the official decision has not yet been made. Swissair technicians are now studying the results of the trial operation.

On one engine, the Twin Pioneer can maintain a ceiling of about 7,000 feet, enough for many civil and military tasks. But here where mountain strips are cleared cow pastures 5,000 or 6,000 feet above sea level, the reserve of power and altitude is too marginal for commercial operations.

To increase that margin, Swissair limited the load capacity of the aircraft to 12 or 13 passengers instead of the design capacity of 16.

In every other respect, Swissair pilots, engineers and technicians associated with the test program are most enthusiastic about the STOL performance of the ungraceful airplane.

Three-Month Trial

The Scottish aircraft completed a three-month trial under charter to Swissair on March 31. Most publicized portion of the trial was the ski-lift to mountain resorts of the Zermatt area. During the trial period, only one spell of bad weather—which shut down all operations at this end of Switzerland—kept the Twin Pioneer on the ground. Its maintenance and operations gave no major or minor troubles, and the airplane was always available for its flexible and rigorous flight schedule.

Utilization for a day's operations including the ski lift trips was about seven and one-half hours flying time. Toward the end of March, early melting of the snows in the mountains turned the field at Zermatt into a mudhole and operations into that area stopped.

During the trial period, a typical flying day started at Basel. The plane flew down to Geneva (128 miles) and then made a round trip to La Chaux-de-Fonds, one of the watchmaking centers, about 3,000 feet elevation in the Jura mountains (132 miles round-trip). It left Geneva to fly to Zermatt and back with skiers (202 miles round-trip) and then made a second run to La Chaux-de-Fonds and back. In the evening it returned to Basel. The day's total: 722 miles.

These are all short hauls, about one

SWISSAIR Twin Pioneer loads passengers at La Chaux-de-Fonds, elevation 3,000 ft.

TWIN PIONEER routes in northern Switzerland parallel Jura mountain ridges.

"SKIERS SPECIAL" Twin Pioneer lands passengers on frozen lake at St. Moritz.

hour's flying time, over mountainous terrain that demands contour flying and precision approaches through the passes and down the slopes. The slatted and flapped Twin Pioneer has the ability to turn on a dime and let down at a high rate of descent with a low forward speed. The long-stroke landing gear is ideal for the rough fields and mountain strips. Cruising speed of about 100 or 105 knots indicated is adequate for the short distances.

Morning Hop

I rode the Twin Pioneer on the short morning hop from Geneva to La Chaux-de-Fonds, about forty minutes away by air. Takeoff was routine and conformed to pattern so there was no chance to see the short-field performance. Takeoff run on concrete was about 12 seconds, and the plane had about 500 feet under it at the end of the 7,500-foot runway.

The impression of the Twin Pioneer in the air is a good one. It has a solid feel and the minor turbulence off the mountain ridges is quickly damped out in the slight swing of the plane. Noise level compares to the Douglas DC-3, and there is the usual drumming of propwash on the fuselage skin and high-frequency vibration in the overhead structure. Furnishings are Spartan—or perhaps Scottish; adequate is the best description.

Cruising speed was approximately 105 knots indicated. The Alvis Leonides powerplants were turning at 2,460 rpm.

Approach to the blacktop strip at La Chaux-de-Fonds was flat and routine; there are none of the funnel-shaped mountain faces to fly down as in the case at Zermatt.

On the return trip, the takeoff run was only nine seconds and the Pioneer, which had been held with brakes while the engines were run up to full power, seemed to leap into the air.

Pilots' Discretion

The route back to Geneva, in common with other routes flown by the Twin on its trial, was left to the discretion of the pilots. They fly VFR on these services and can pick the route they feel is best. They know the country they fly over probably better than any other group of airline pilots around, because in their spare time, many of them fly sailplanes over these same mountains, feeling for winds and avoiding severe turbulence.

We flew parallel to the ridges of the Jura range, while the pilots worked back toward Geneva by flying through passes from one valley to the next.

Landing and ground routine at Geneva was to pattern.

Swissair's interest in the Twin Pioneer is probably a unique one, geared to that portion of the Swiss economy that lives on tourist trade. Like most European carriers, Swissair is in competition inside its own country with high-speed, frequent and comfortable train service. The tiny size of Switzerland—about the area of Rhode Island, Connecticut and Vermont—means that there has been little internal air service. The cost of building airports and facilities to handle contemporary aircraft at small towns is prohibitive, and there isn't much time to be saved anyway.

But at the mountain resorts the story is different. Swissair would like to be able to sell tickets to skiers from New York to a spot like St. Moritz. The aircraft needed for such a service would need a capacity near that of a DC-3 and the ability to operate in and out of mountainous fields "just big enough to feed two cows." The Twin Pioneer looked like the ideal candidate for the job, but the trial period has shown otherwise.

Two Possibilities

Swissair has suggested two possibilities to Scottish Aviation for meeting Swiss certification requirements. First, the Alvis piston engines could be replaced by two Turbomeca turboprops to give more power for the same or lower installed weight. Second, a small turbojet engine could be mounted in

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These three companies employing 107,000 people, with sales in 1956 totaling one billion, two hundred sixty-six million dollars, announce the signing of agreements providing for a fully-integrated program of engineering, production, sales and service of automotive vehicles; automotive, marine and industrial gasoline and diesel engines; and diesel and gasoline fuel injection systems. All of these companies have been associated for years with quality, precision manufacture and high-performance products.

Pursuant to these agreements, Daimler-Benz and Curtiss-Wright have formed an American company — Curtiss-Wright and Mercedes-Benz, Inc. — to provide for the development and sale of Daimler-Benz products in the United States, Canada, Mexico and Cuba.

Studebaker-Packard Corporation in signing the agreements will now make available to its dealers a full line of domestic and imported sports cars, convertibles, sedans and station wagons — ranging in price from under $2,000 up to $13,000 — gasoline and diesel powered trucks and all-wheel drive utility vehicles.

Mercedes-Benz cars and distinctive Mercedes-Benz features — such as fine coachwork, swing axles and transmissions — will be exclusive to Studebaker-Packard.

The Utica-Bend Division of Curtiss-Wright Corporation, now building diesel engines for the U. S. Navy, will import and manufacture Mercedes-Benz diesel engines and diesel and gasoline engine fuel injection systems under the agreements. The engines will range from a 4-cylinder model of 25 h.p. to a supercharged 8-cylinder model of 600 h.p.

Further agreements are being negotiated between Daimler-Benz and Curtiss-Wright Corporation for the interchange of rights for the manufacture of aircraft products.

Carl F. Giese
President, Daimler-Benz of North America, Inc.

Roy T. Hurley
Chairman and President, Curtiss-Wright Corporation

H. E. Churchill
President, Studebaker-Packard Corporation

the tail of the plane and cut in during takeoffs and landings to provide the extra margin of power should one engine cut out during those critical moments.

Either development would take considerable time to engineer and get into production. Meantime Swissair faces a problem that has yet to be solved: How to transport a sizable portion of the tourist trade from its major international airports at Geneva and Zurich to the mountain resorts that account for, next to watchmaking, the biggest portion of this country's economy.

SOUND-ABSORBING qualities of new Convair test chamber are measured by acoustic engineers Gerard Bosco (left) and Frank Dalzell. Walls, floor and ceiling of the anechoic chamber are lined with glass fiber shaped into patterned wedges. Floor grating is removed during tests of materials.

Sound Chamber Built for 880

San Diego—Convair is building a new $91,000 sound laboratory to test materials and components scheduled for use in its Convair 880 jet transport. Object is to determine what materials will provide quietest possible passenger compartment.

Two of the three lab units are completed. Construction of a third will start soon. In use are a reverberation (sound reflecting room) and an anechoic (echo-free) chamber.

Electronic noise generators, amplifiers and loudspeakers project the required volume and frequency of sound simulating jet engine exhaust noise and the sounds made by air passing over the aircraft's external skin at high speeds.

Modular concrete walls break up the sound waves in the reverberation room. In the anechoic chamber all interior surfaces—walls, floor and ceiling—are lined thickly with glass fiber shaped

In 1883, Gottlieb Daimler built the world's first high revolution gasoline engine.

In 1884, Karl Benz obtained the world's first patent for a motor vehicle.

In 1926, these two pioneering manufacturers joined in a merger to form the present Daimler-Benz A. G., Stuttgart, West Germany

Today, Daimler-Benz builds the world's finest automobiles — the Mercedes-Benz — and produces diesel powered trucks and tractors, and diesel engines from 10 to 3000 horsepower for marine, rail and industrial uses.

The company exports from Germany to 128 foreign countries through more than 1,100 agencies and distributors and operates assembly and production facilities in 27 foreign countries.

Daimler-Benz today employs 53,000 in Germany and an additional 13,000 outside Germany.

Sales in 1956 were $392,000,000.

In 1903, Orville and Wilbur Wright flew for the first time in history with an airplane and engine of their own design. Glenn H. Curtiss pioneered in aircraft development during the same period.

In 1929, the Curtiss-Wright Corporation was formed by merging the companies founded by the Wright Brothers and Curtiss.

Today, Curtiss-Wright is a leading producer of aircraft engines, missiles, propellers, electronic flight simulators, and other aircraft equipment for the military and the commercial airlines, as well as products in the fields of electronics, ultrasonics, nucleonics, thermodynamics, plastics and metallurgy. The fastest airliners in operation today are powered by Curtiss-Wright engines. A Curtiss-Wright rocket engine powered the Bell X2 to world speed and altitude records.

Curtiss-Wright employs 32,000 in 17 divisions and subsidiaries in the United States and two foreign countries and exports products throughout the world.

Sales in 1956 were $571,000,000.

Beginning as wagon manufacturers in 1852, the Studebaker Brothers produced a 16 horsepower gasoline powered car in 1904 at South Bend, Indiana.

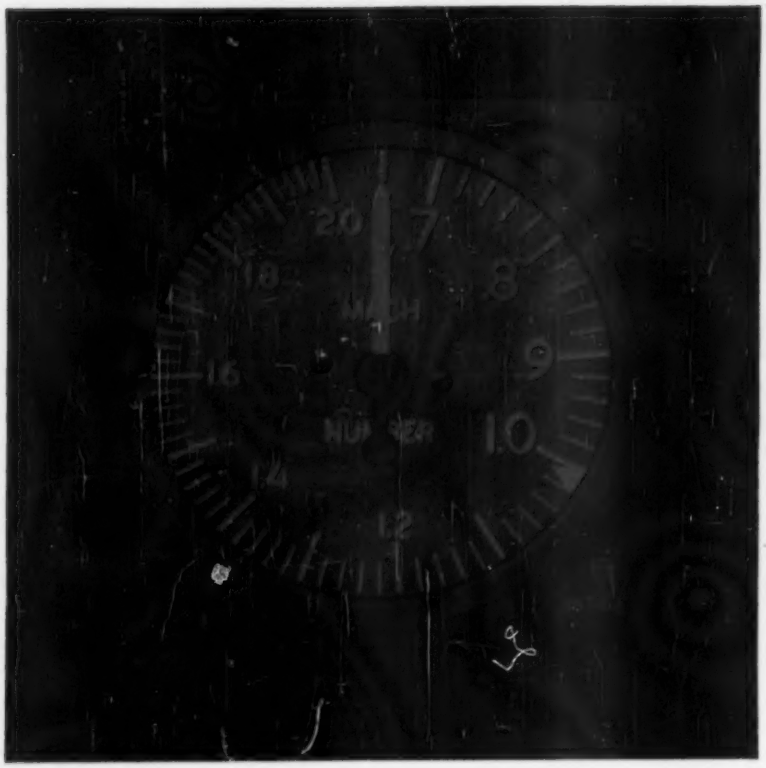
In 1899, the Packard Motor Company produced a 12 horsepower car at Warren, Ohio.

In 1954, Studebaker-Packard Corporation was formed through a combination of these two companies. Today, Studebaker-Packard Corporation manufactures a complete line of passenger cars, trucks, and station-wagons which are distributed throughout the world and sold by more than 2,400 dealers in the United States and Canada. The company pioneered modern supercharged engines, low silhouette jet styling, twin-traction rear axles, torsion springing and finned, air-cooled brakes.

The company's products are assembled in plants operating in 11 foreign countries.

Studebaker-Packard Corporation employs 9,000 at South Bend, Indiana.

Sales in 1956 were $303,000,000.



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Pioneer-Central Gives You Integral Lighting

Panel instruments that can be read at a glance—now offered by Pioneer-Central. Air Speed, Rate of Climb, Turn and Slip and a variety of other instruments, including the Machmeter shown above, now available with Integral Lighting. All units comply with Lighting Specification MIL-L-25467A.

Numerals on instruments are sharply contrasted, reading white by day and red by night—the color science has proved best suited for sharp readability with minimum effect on "dark-adapted" eyes.

Lighting is even and shadowless, with a uniformity of .5 to 1.5 foot lamberts. There is no "jumpiness" of graduations and numerals. A minimum of three long-life bulbs in each instrument assures top dependability, admits no "stray lighting". Light is directed only at the dial. Arrange for a demonstration. PIONEER-CENTRAL DIVISION OF BENDIX AVIATION CORPORATION, DAVENPORT, IOWA.

West Coast Office: 117 E. Providencia, Burbank, Calif.
Export Sales & Service: Bendix International Division, 205 E. 42nd St., New York 17, N. Y.
Canadian Affiliate: Aviation Electric, Ltd., 200 Laurentian Blvd., Montreal, Quebec

Pioneer-Central Division
DAVENPORT, IOWA

Bendix
AVIATION CORPORATION

FOUR-WHEEL bogie landing gear for Convair 880 jet transport is mocked up at Convair San Diego plant. Cockpit installation in mockup is complete and air conditioning and lighting will be completed this month.

into wedges by heavy wire mesh and mounted on the wall surfaces in a regular pattern. The glass fiber wedges trap and absorb any sound transmitted through a test specimen into the anechoic chamber. The fiber itself attenuates high frequencies, the wedge shapes absorb low frequencies.

The material samples are mounted in a throat area between the two rooms.

In the laboratory's third unit, a full scale 20-ft. metal section of the 880 will be tested as a whole to ascertain the interaction of interior trim, seats, fuselage, insulation, skin, windows and other components in relation to cabin noise levels.

The new laboratory was designed in consulation with Bolt, Beranek & Newman, Inc., of Cambridge, Mass.

GE to Build Hangars At Edwards for USAF

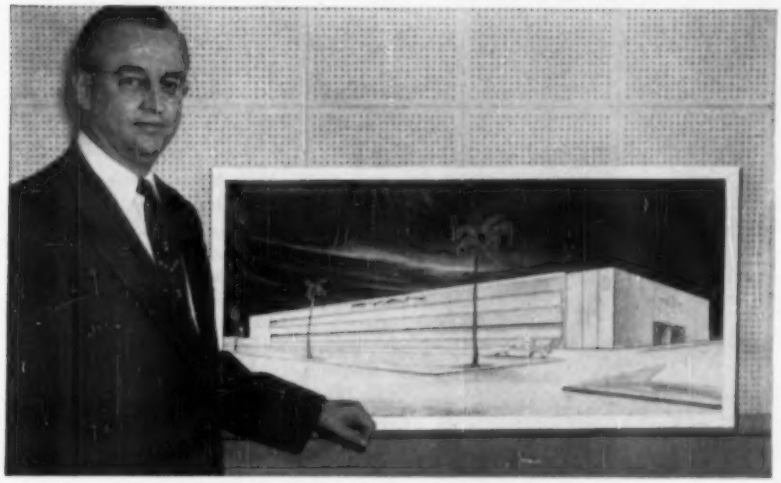
Cincinnati—General Electric Co. has started construction of four flight test hangars at Edwards Air Force Base, Calif., under a $4,512,000 facilities contract with the Air Force.

Structures will be used by aircraft engine contractors for flight test, minor design modification and instrumentation work. GE is conducting advance tests at Edwards on the J79 which powers the Convair B-58 Hustler bomber.

Other three hangars will be assigned to Pratt & Whitney, Curtiss-Wright and Allison. Completion is scheduled for early 1958. Hangars will be built by Maderback Construction Co., Glendale, Calif.

REPORT FROM RYAN

New Engineering Opportunities Created as Ryan Projects Mushroom



FRANK W. FINK, RYAN VICE PRESIDENT AND CHIEF ENGINEER inspects architect's drawing of new Engineering and Research Center.

New Engineering and Research Center To Meet Ryan's Expansion

Construction of a modern two-story, engineering and laboratories building has begun at Ryan, to meet the company's expanding work in Jet VTOL—Automatic Navigation—Jet Drones—Missile Guidance—Jet Metallurgy—Rockets.

The new facility will provide additional quarters for many of the 1000 employees in Ryan's fast-growing engineering division. It will also house complex, new chemical, metallurgical, instrumentation, environmental and autopilot equipment.

With one in six Ryan employees in engineering, this division has tripled in three years. Its mushrooming growth reflects Ryan's increased importance as a research facility in aerodynamics, propulsion and electronics.

RYAN ENGINEER "zooms" straight up in unique rotatable cockpit.

Vertical Flight Probed with New VTOL Cockpit

Shortest way into the sky is straight up—in the Ryan Vertijet. To probe this new realm of flight without becoming airborne is a trick performed daily by Ryan engineers. Their secret? A rotatable cockpit connected with electronic computers.

Ryan's flight simulation laboratory is a prime tool in the test of new aircraft designs. Both the Vertijet and the subsonic, turboprop-driven Vertiplane are put through their paces via earthbound flight test. Ryan leadership in this revolutionary new concept of flight is based upon 2¼ million manhours of VTOL research and development. It is another example of how Ryan builds better.

Ryan Automatic Navigator Guides Global Flight

An advanced system of aerial navigation, designed for high speed, long range flight, has been developed by Ryan electronics engineers, working under sponsorship of the Navy's Bureau of Aeronautics.

Designated AN/APN-67, the new navigator is the lightest, most compact, self-contained electronic navigator in production. Developed to meet military needs, it will also meet commercial jet flight requirements.

The system provides pilots and navigators with continuous information on longitude, ground speed, ground mileage, drift angle and ground track. It is accurate and instantaneous. Requires no computations, ground facilities or wind data.

AUTOMATIC NAVIGATOR guides pilots with single instrument (above).

Ryan has immediate career openings for engineers

Look to the future. Look to Ryan . . . where you can grow with an aggressive, forward-looking company. You'll find a variety of stimulating projects. Ryan engages in all three elements of modern flight vehicles—airframes, engines to propel them and electronics equipment to guide them.

Send today for Ryan's brochure, "Engineering Opportunities". Mail this coupon to:

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Ryan Aeronautical Company
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San Diego 12, California

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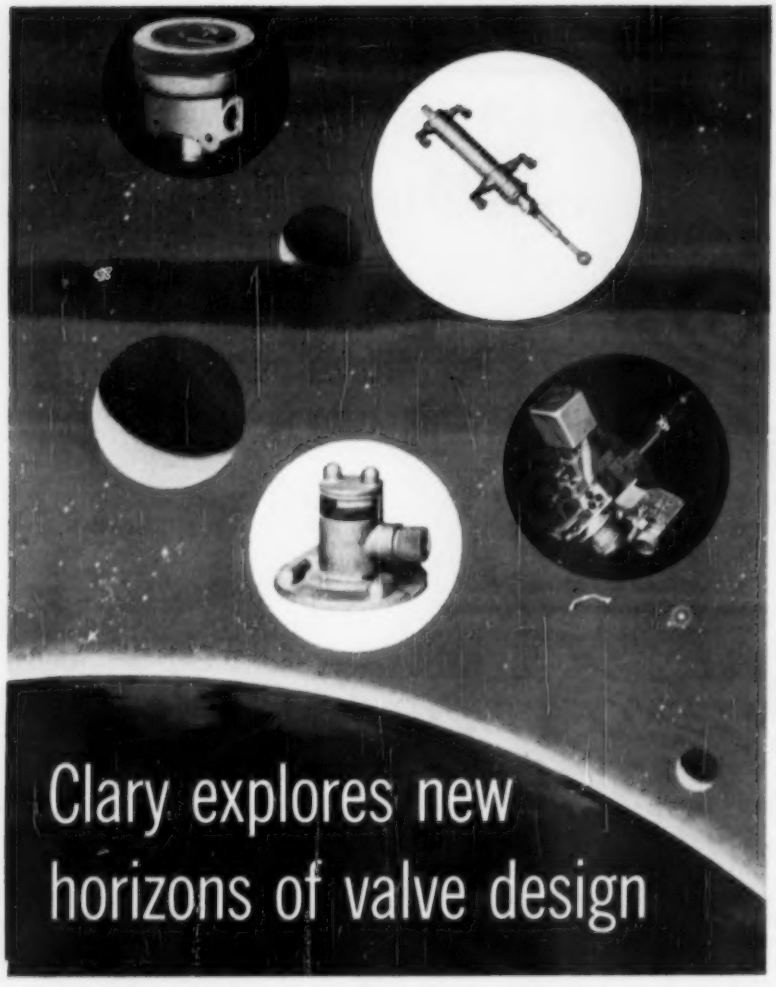

Clary valves do things *now* you might not expect valves to do for another five years. Their unusual designs are contributing to the success of many of today's leading air frame and missile projects.

There is a good possibility that Clary valves and valve experience can be of help to *you*. We believe you will find our manufacturing facilities, test equipment and engineering staffs well able to help solve your problems. A few of the many valves we have developed are described below. Get in touch with us soon, won't you?

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ACTUATORS for hydraulic or pneumatic service. Clary provides valves operating with MIL-L-7808 Oil to 500°F.; MIL-O-5606 Oil for regular service; brake cylinders with built-in control transfer; servo-pneumatic actuators; pneumatic cylinders for high temperature service (now under development are pneumatic actuators and selector valves for operation with gas temperatures of 750°F.).

RESTRICTOR, RELIEF AND DRAIN VALVES for gas or liquid systems, are a Clary specialty. Available are units built to standard MIL specifications, as well as custom designs.

Manufacturer of business machines, data-handling equipment, aircraft and missile components

High R&D Spending Cited by Bell Chief

Ft. Worth—Aircraft companies spend a greater part of their income on research and development than any other industry, according to Leston Faneuf, Bell Aircraft Corp. President.

Noting that the aircraft industry spends 13% of its sales dollar for R&D, Faneuf pointed out that this figure is highly significant in view of the fact that the industry is the largest employer in the nation.

The Bell official's observations were made at the recent annual meeting of the Ft. Worth Chapter of the Texas Manufacturers Assn.

Tracing the growth of research in U.S. industry, Faneuf said that expenditures have increased from $200 million in 1930 to $4 billion last year, to a large degree as a result of wartime research. He observed that the National Industrial Conference Board predicts expenditures of $8 billion by 1960 and $20 billion by 1976.

In 1954, government supplied 59% of total research funds of nearly $4 billion, but government agencies used only 17%. Balance of government money was spent by industry, Faneuf said, along with industry's contribution of 39% of total R&D funds. Thus, industry controls most of the R&D money spent in spite of the fact that it contributes less than half the total from its own funds.

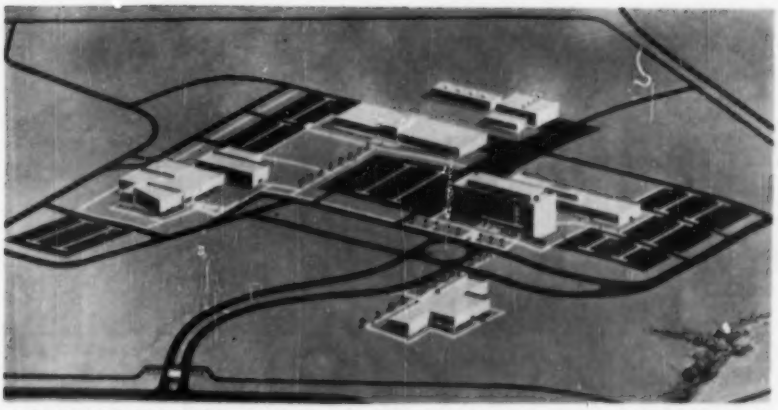
Faneuf observed that this tremendous expansion of R&D activity has been marked by a trend away from individual inventors toward large research teams. He traced this trend to the great amounts of money needed for modern research and to the broader scientific aspects of current work.

Turning to R&D efforts in the Ft. Worth-Dallas area, Faneuf said that the dollar amount of research done here is considerably higher than the national average ratio of sales to research, primarily because of the high concentration of defense industry in the area.

Manufacturing sales in the area totaled nearly $963 million last year, with about $106 million going to research and development. This means than 11% of total sales was invested in research, Faneuf said.

A survey of the Ft. Worth-Dallas area shows that 44 companies employ more than 4,550 persons in research work, and a sample of 16 leading R&D-type companies shows that the average research employee is paid about $9,600 a year.

Faneuf said the Bell Helicopter Corp. had 350 of its people engaged in management, services and production activity at the beginning of 1957.



ARCHITECT'S DRAWING of new School of Aviation Medicine to be built at Brooks Air Force Base, Texas. At left is Academic Building with two story Aviation Medicine Examining Wing projecting from far end. Long low building (center) is Altitude Laboratory. Tallest structure (right) is Research Institute, also school headquarters. Foreground (right center) is Flight Medicine Laboratory. View faces south from San Antonio Military Highway at northwest corner of base.

USAF Builds Medical School Units

San Antonio—Construction of a new $9 million installation for the Air Force School of Aviation Medicine is under way at Brooks Air Force Base.

Contracts have been signed for construction of four major buildings at the new facility, and the school is scheduled to move to its new quarters by July, 1959.

Now under construction are the Research Institute, Academic Building, Flight Medicine Laboratory, shops and cooling and heating plants. Altitude Laboratory will be added later.

School of Aviation Medicine is currently housed in more than 40 buildings at Randolph AFB here. Plans for a permanent facility have been in the works since 1946, but Congress didn't approve funds for the project until 1952.

After several further delays, construction work has finally started.

Main structure at the new facility will be the four-story Academic Building. It will house the school's headquarters, aeromedical library and experimental laboratories.

Academic Building will have 16 class rooms with a total capacity of 700 students and an auditorium that will seat 400. One wing will be devoted to teaching of specialized techniques for examining flyers.

Flight Medicine Laboratory will be the central Air Force repository for records of physical examinations performed on pilots and air crews. The building will also be used to develop and evaluate tests of flying fitness.

In the shops, instruments for research projects will be fabricated. Shops also will contain electronic equipment for analyzing statistical data and will house the medical photographic library.

Altitude Building will be fitted with $2 million worth of atmospheric pressure chambers. Some of the chambers will be used for research, others to familiarize medical officers with high altitude conditions.

Original plans called for a small hospital for demonstration of clinical procedures and to provide space for observation and treatment of patients sent to the school for consultation. To save money, this facility has been eliminated, and these functions will be provided by the Lackland AFB hospital.

Convair, Ryan Plan Engineer Facilities

Approximately 400,000 sq. ft. of floor space will be renovated in Convair-San Diego engineering buildings under a $3 million program announced by B. F. Coggan, San Diego manager.

Construction is due to start in the Fall. Drawings and specifications are being prepared now by a San Diego architect firm of Paderewski, Mitchell and Dean.

Work will be done in phases extending through 1958. Some 3,500 engineering personnel work in the two affected buildings.

Ryan Aeronautical Co., San Diego, Calif., has started construction on a new half-million dollar engineering and laboratories building, according to a recent announcement of T. Claude Ryan, president.

The two-story 340 ft. long building will contain laboratory equipment for chemical, metallurgical, instrumentation, environmental, physical, hydraulic and autopilot testing.

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Here's Why General Electric's New

BEST POWERPLANT

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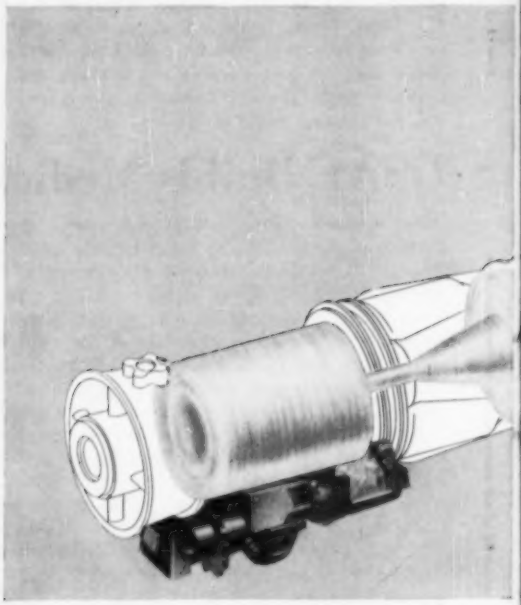
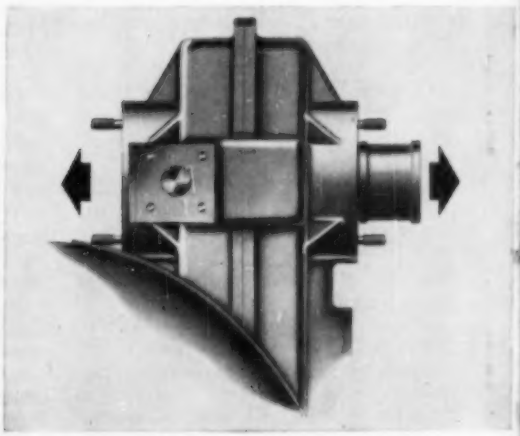


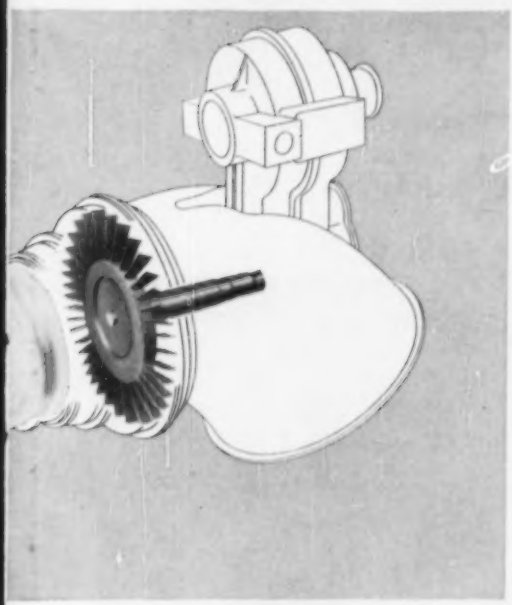
T58'S ADVANCED CONTROLS, FREE TURBINE DESIGN help simplify pilot duty; allow the



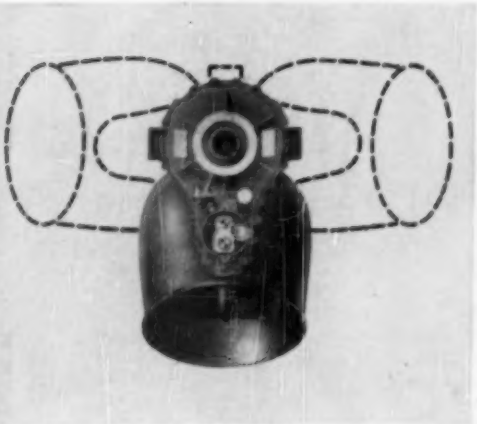
T58'S MAIN REDUCTION GEAR permits convenient fore or aft power extraction.

T58 Turboshaft Engine Is The

FOR HELICOPTERS



helicopter rotor to operate at best speeds for climb, cruise, or hover conditions.



T58'S 3-POSITION EXHAUST NOZZLE mounts vertically or at 90-degree angles.

Offers unmatched performance capability; advanced mechanical design features

Over 3:1 Power-to-weight Ratio—Packing more power per pound than any other gas turbine engine of comparable output, the T58 delivers 1024 horsepower yet weighs only 325 pounds (including 75-lb reduction gear). What will the T58's low weight mean to future helicopters? Drastic reductions in their gross weight—up to 40% faster cruising speeds—greater endurance—and vastly increased ton-mile capacity. In addition, the T58's advanced aerodynamic and lightweight mechanical design promises the same high reliability that has been *proven* in G.E.'s J47, J73, and supersonic J79 jet engines.

0.69 Specific Fuel Consumption (normal, with gear)—The T58's turbine inlet temperatures, pressure ratios and the aerodynamic design of its major components have been balanced to provide the highest possible operating efficiency over a wide range of helicopter flight conditions. Result: a *proven SFC* that rivals the piston engine for economical operation.

Automatic Rotor Speed Control—The T58's revolutionary new constant-speed control eliminates the need for speed adjustments by the pilot during normal flight operation. Combined with the T58's free power turbine, this new control automatically regulates engine output to meet changes in load or flight attitude, thus permitting the helicopter rotor to operate at the most efficient speeds for take-off, climb, cruise and hover.

Small Envelope Size—Measuring only 59 inches long by 16 inches at maximum flange, the T58 makes possible more compact engine compartment design, additional cargo space.

Versatile Exhaust & Power Take-off Arrangement—The engine's 3-position exhaust and fore or aft power take-off arrangement also simplify problems of designing or retrofitting engine compartments in either single- or multi-engine helicopters.

The T58 was developed for the Navy by General Electric's Small Aircraft Engine Dept. General Electric believes the T58's many features make it the best engine of its kind to transform the role and performance of helicopters into new levels of military and commercial usefulness. For detailed performance data, call your local G-E Aviation & Defense Industries Sales Office, or write: General Electric Co., Section 233-5, Schenectady 5, New York, for T58 brochure.

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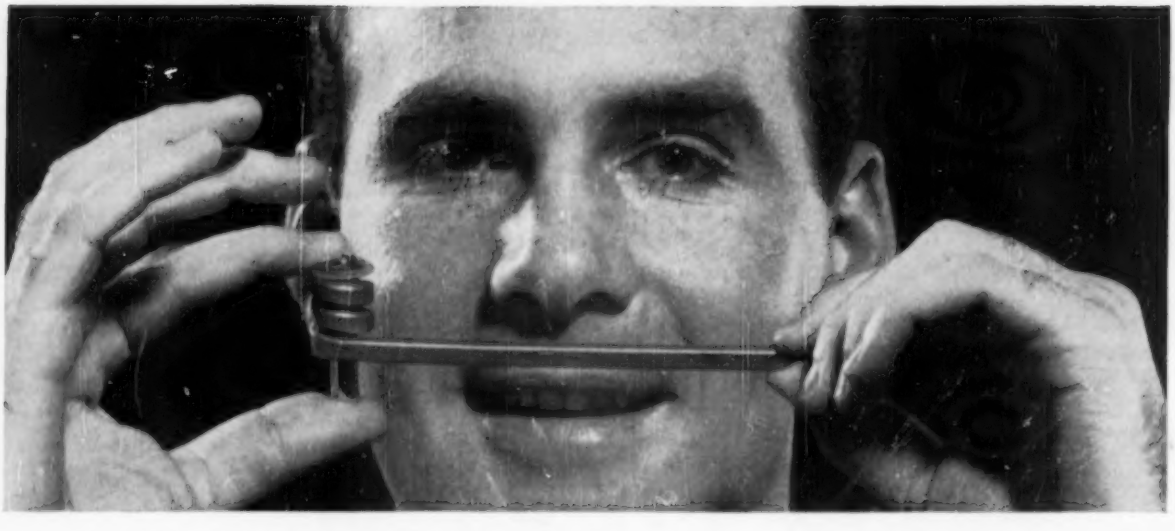

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Circuit breakers

Smaller Companies Combine to Compete

By Philip J. Klass

Medium-size avionics companies, too small to win prime contracts for many of the complex weapon systems but too big to be content with subcontracts, are joining forces to compete with the industry's larger firms.

These combines, which could reshape present business-management patterns, range from the formation of a new corporation to perform systems engineering for its member firms to a loose federation of firms that pool their talents for a joint weapon system proposal.

These moves could lead eventually to the formation of large new avionics companies through corporate merger, but that is not the present objective.

The two companies in the forefront of this new movement are:

• **Hoffman Electronics Corp.** Company President H. L. Hoffman has been quietly sounding out other medium-size avionic and non-avionic firms to join in setting up a new company for the specific purpose of assuming system management functions for its participating members and submitting joint proposals on complex weapon system procurement. Hoffman told AVIATION WEEK that he hopes to have the new organization set up by the end of the year.

• **Emerson Radio & Phonograph Company's Government Electronics Division.** Emerson has worked up a loose federation of roughly a dozen other medium size firms, some avionic, others in fields like rocket propulsion, and has established corporate and technical liaison between these associates, as they are called. When a new military requirement comes up, management and technical committees are formed for the project with a representative from each of the associates whose skills are required. In working up a proposal, the committee decides which company will function as prime contractor and the company then submits the joint system proposal in its own name.

It is interesting to note that the trend toward more complex weapon systems runs counter to the modern management philosophy of decentralization. Autonomous divisions in a large company frequently face much the same problems as medium-size avionics firms in organizing their technical forces for a major weapon system program.

This was one of the factors behind Bendix Aviation's recent move to set up a corporate Systems Division at Ann Arbor, Mich. Radio Corporation of America recently set up a similar division and Sperry Gyroscope Co. has reshuffled its operations in recognition of the trend toward complex weapon system programs.

General Electric, which has a number of semi-autonomous departments, each with annual gross sales of $50 to $200 million, is seriously considering the formation of a systems management operation. A GE official says he suspects that the company has lost position in one segment of the avionics business as a direct result of the fact that individual portions of the system are assigned to separate departments.

Caught in the Middle

The firms that have been caught in the middle by the trend to large complex weapon systems usually are those whose annual sales range between $20 and $80 million and which employ between 200 and 800 engineers.

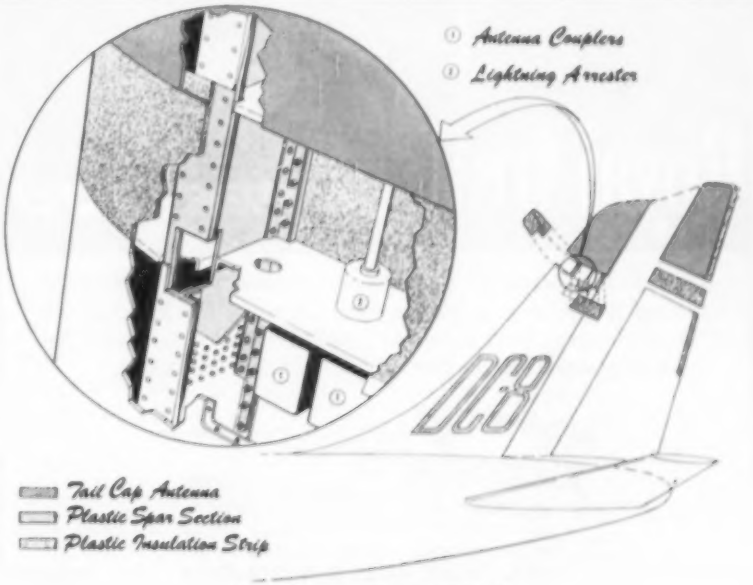
Such firms usually are specialists in one or two fields, such as flight control, fire control, navigation or communications.

Many have grown to their present size as a result of competence in these fields. The quantity and quality of the medium-size company's engineering staff may equal or exceed that of the big firms in the former's field of specialization.

Valuable Source

Paul B. Wishart, president of Minneapolis-Honeywell, whose Aeronautical Division probably falls in the medium-size category, says: "Ideas still spring from individuals. Many of the best of these ideas have come from one man or a few men employed by the small, highly specialized company rather than from the large corps of engineers and research scientists maintained by the so-called industrial giant.

"The small company which understands and concentrates on its own field," Wishart says, "frequently thinks further ahead in the development of that product line than does the large company where pioneering effort is likely to be diluted in the whole program of the company's varied interests. Finally, the most productive original ideas are likely to reach the top quickly in a small operation, to get a full hearing, an adequate trial and a success-



Antenna for DC-8

Douglas has selected an isolated tail-cap antenna for high frequency communications use in its new DC-8 jetliner. Douglas says the antenna, used on its military jets, was selected after analysis of other type HF antennas, including the probe type which Boeing reportedly will use on its 707 jetliner. Protection from lightning strikes will be provided by arrester which forms part of automatic antenna coupler.

ful application to a problem that looms large in the small company."

Even a complex like General Electric probably would not take issue with these basic philosophies since they are one of the strong motivations behind GE's own decentralization program which generally has proven to be beneficial in many of the company's lines of endeavor.

Difficult To Manage

The complexity and advanced technological nature of modern weapon system developments require so much technical and management depth that the military has been forced to seek outside assistance. Usually this responsibility has been delegated to a major firm in the aircraft, avionics or automotive field, or to a special organization specifically assembled for the purpose. For example:

- **Prime contractor,** such as Convair for the B-58 and American Telephone & Telegraph Co. for the DEW Line.
- **Special facility,** such as the Massachusetts Institute of Technology's Lincoln Laboratory, which is developing the SAGE air defense system.
- **Management contract,** such as the USAF's intercontinental ballistic missile program at The Ramo-Wooldridge Corp.

It appears unlikely that the military will find many companies anxious to take on a Ramo-Wooldridge type management contract. For one thing, the profit return to the company on its high-powered talent is very low. Secondly, the terms of the contract at R-W prohibit it from supplying any of the equipment used, in order to assure that its management judgment will be unbiased. This excludes the company from participating in a major program which could be a source of profitable production. Finally, if the scientific personnel who manage such a program remain away from their laboratories and from hardware for too long, there is danger of their losing some of their technical competence.

Favored Type

This explains why the prime contractor type of weapon system management has proven most popular. Most of these contracts have gone to large companies that have all or most of the needed skills under one corporate roof and which are large enough to assume financial responsibility for a major program.

However, Les Hoffman believes that the selection of large companies frequently results in "heavy echelons of command between the scientist who does the work and the top management that makes the decisions and this has a tendency to smother creativity."

Hoffman and Emerson believe that there is an alternative which can open up new sources for weapon system management, yet can use existing know-how, facilities and management.

Hoffman proposes to get four or more

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Phone: RA 3-2204

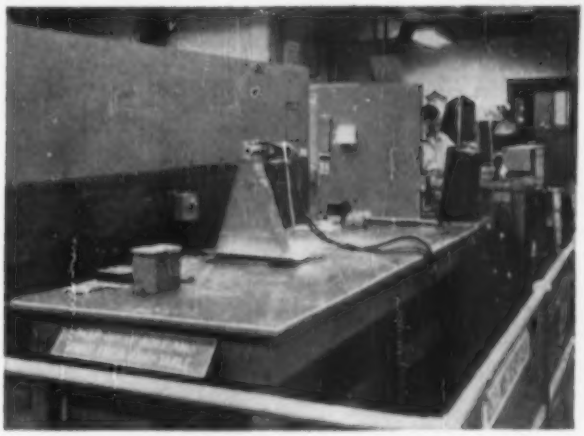
SAN FRANCISCO, CALIFORNIA
Commodore Air Service
Phone: Sausalito 100

New Gyro Compass

New polar gyro-compass reportedly has random drift rate of less than ½ degree per hour, permitting use at high latitudes where magnetic slaving can not be employed. Developed by Sperry Gyroscope Co., new C-11 system weighs only 21 lb., including controller to provide automatic correction for earth's rotation, an all-transistor amplifier, compass element and master indicator.

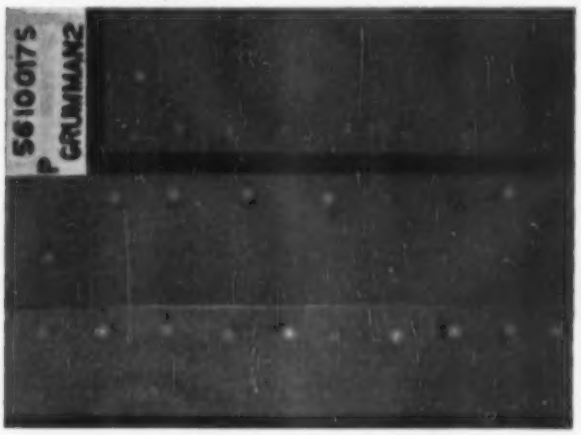
One Minute X-ray Inspection at Grumman Aircraft

X-RAY WITHOUT DELAY This is one of three radiographic stations in the Grumman Bethpage plant where production spotwelds are inspected. Finished sections flow to it as they are completed.



QUICK, SAFE SETUP The radiographer lays the section on a loaded Picker-Polaroid cassette, positions the x-ray tube over it. On completing the setup he steps behind the lead screen and makes the 15 second exposure.

FINISHED IN ONE MINUTE He drops the exposed cassette into the Picker-Polaroid processor, snaps the cover down. One minute later out comes the fully developed x-ray.



NO DARK ROOM, NO SOLUTIONS Here's how the resultant Picker-Polaroid radiograph looks—a glossy dry 10" x 12" picture, easily read in ordinary light without using an Illuminator.

Aircraft spotwelds have to be sound . . . or else. To keep them so, Grumman Aircraft radiographs spotwelded body sections right on the production line without interrupting work flow. A Picker 50 KV x-ray unit does the job (see it there behind the lead screen . . . no bigger than a filing cabinet. The x-ray tube comes out on extension lines for remote work like this). 15 seconds for the x-ray exposure; one minute for processing . . . so it goes day in and day out, standing vigilant watch over Grumman's high quality standards.

If you, too, need to spot hidden defects to keep a firm finger on quality control, we'll be glad to tell you what this unique unit (or others in the broad Picker x-ray and gamma line) can do for you.*

*There's probably a Picker District office near you (see local 'phone book). Or write Picker X-Ray Corporation, 25 South Broadway, White Plains, New York.

some other Picker units . . .

150 KV
up to 1" steel, 5½" aluminum

270 KV
lightweight, portable

260 KV
for heavy duty inspection

GAMMA
Technical Operations
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eliminate lead-lined rooms

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if it has to do with radiography it has to do with Picker x-ray

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Unit construction, an exclusive feature of General Electric thermocouple systems, assures an accurate, reliable, and long lasting temperature detector for the most modern jet engines.

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ACCURATE TEMPERATURE READINGS and reliable operation in the most advanced aircraft are assured by General Electric harnesses and connectors which resist ambient temperatures to 1500°F.

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HIGH ACCURACY and long life are assured by General Electric thermocouple systems because unit construction increases resistance to high ambient temperatures and reduces the number of error-causing mechanical connections.

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GENERAL ELECTRIC

companies to jointly finance the formation of a systems management corporation, with each represented on the new firm's board of directors. The new company would then assemble a staff of systems engineers and management people, both from its member corporations and from outside.

When a new military requirement appeared on the horizon, the systems management corporation would work out a proposal using its own skills plus those within the engineering organizations of its founders. The proposal would be submitted by the new systems management corporation.

Free Selection

Hoffman says that programs would be sub-contracted to participating companies according to their skills and aptitudes. However, he recognizes that the systems management corporation must be free to select the best available sources for any job, even if this means buying from a company outside the family.

Hoffman told AVIATION WEEK that he has sounded out seven or eight companies already and found most of them receptive if not eager to go ahead. Some are avionics manufacturers, several are not. He also has discussed the plan with top military officials and says they were also receptive.

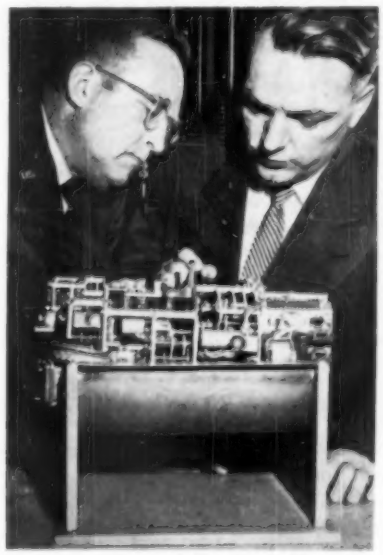
There are precedents for such a joint corporate venture, particularly in the field of large-scale construction, such as the building of major dams, Hoffman pointed out.

Emerson is using a different approach to the same problem. It has formed a loose federation of about a dozen medium-size companies, both avionic and non-avionic. Emerson first studied its own in-house capabilities, then went out to line up associates with technical skills in areas where Emerson had a void—for example, in infrared, airframe and rocket propulsion design.

Emerson reassured its associates that it would not use the relationship to gain their skills, then later invade the technical areas of its associates.

When a new military requirement comes up, each associate with capabilities which are needed is asked to appoint representatives to a technical and to a management committee formed for this specific project. Each committee then appoints a project manager, usually from the company that will carry a major share of the program and which will serve as the prime contractor in the event that the proposal is selected by the military.

When one of the associates gets wind of an upcoming requirement before the military officially asks for proposals, the



Central Computer

Central air data computer, to be used on Republic F-105 and McDonnell F-101B, provides single integrated source of altitude, airspeed, temperature signals for aircraft flight control, fire control, bombing-navigation, engine control, reconnaissance and air conditioning systems. Device was developed and will be produced by Eclipse-Pioneer division of Bendix Aviation under a $7½-million contract.

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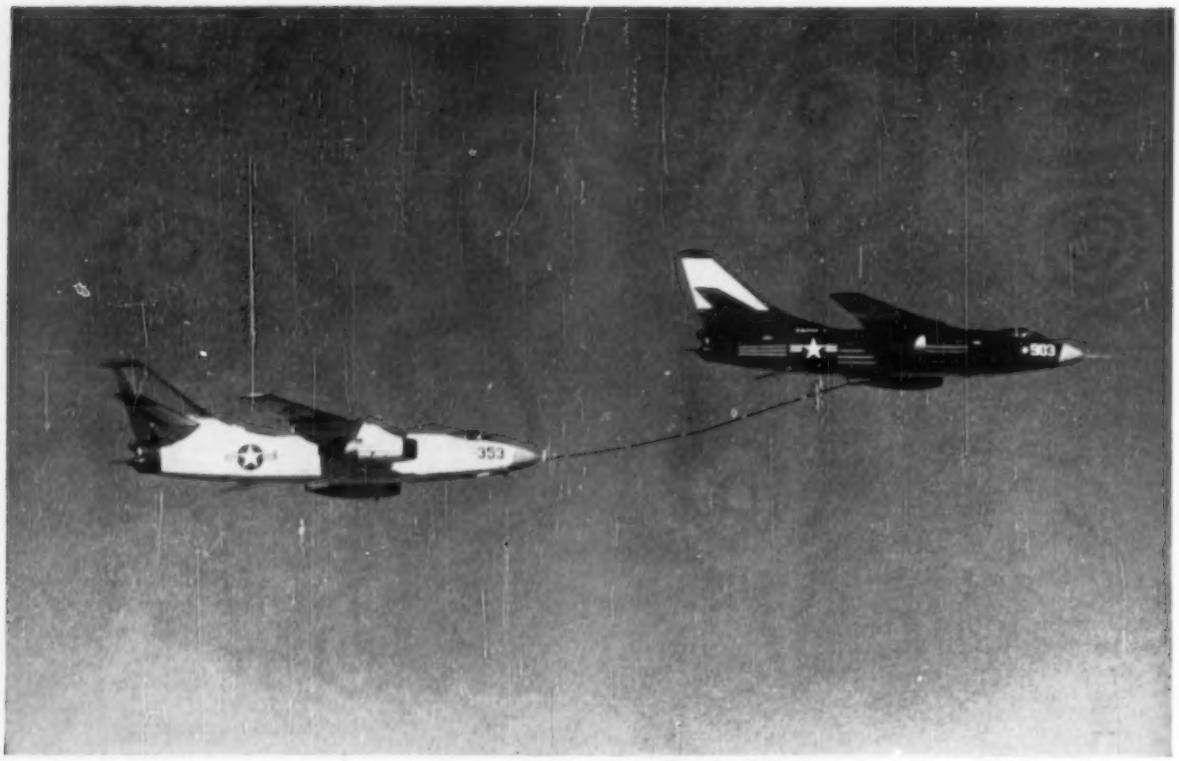

Douglas A3D Skywarrior taking on fuel from A3D tanker

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Tiny TV Camera

Miniature TV camera, suitable for airborne, mobile and closed-circuit applications, weighs less than a pound, measures approximately 2 x 2½ x 4½ in. Developed by Radio Corporation of America, device requires only 10 foot-candles of illumination when used with an F-1.9 lens to provide clear pictures with good contrast.

committees are formed immediately. In one case where this was done, when the definitive requirement was issued the project committees decided that the services of one of the associates on the committee would not be required. The associate was asked to step out which it did "gracef::lly," according to an Emerson spokesman.

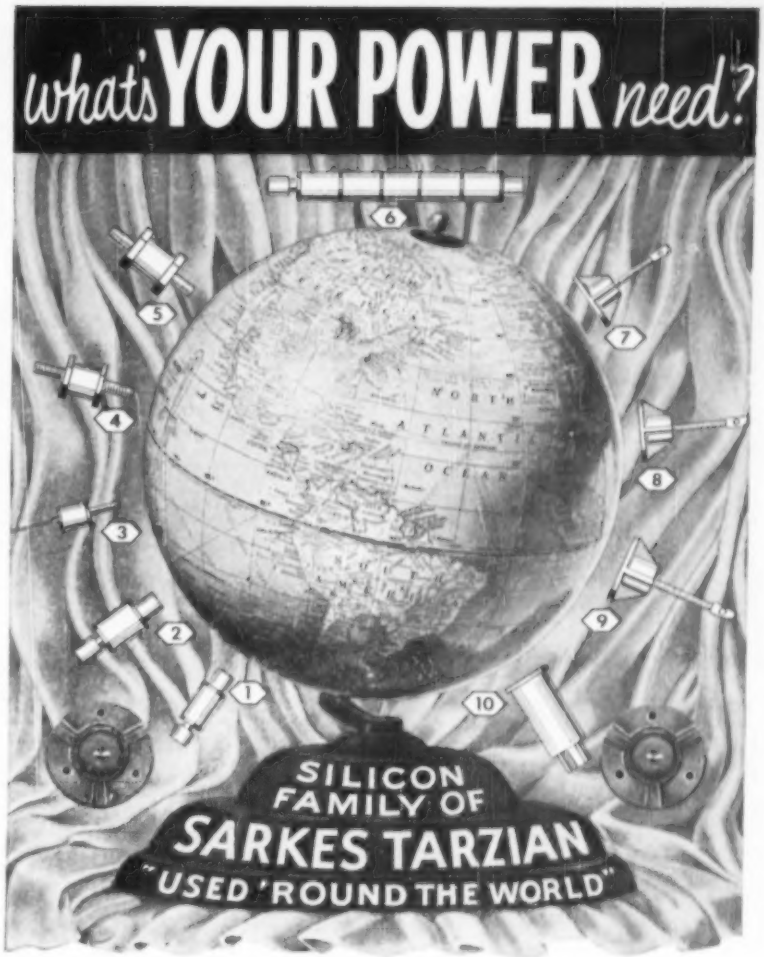
One interesting aspect of the Emerson plan is that the associate selected as the prime contractor will not take a profit on the subcontracts to its associates. This is at sharp variance with usual practice. Even with a large firm it is customary for the department serving as prime contractor to take a small profit mark-up on the subcontracts to other departments within the company, which also take a profit mark-up.

Emerson and its associates already have submitted one major proposal under the new federation and currently are working on another.

Bendix Operation

The operation of Bendix Aviation's new Systems Division bears some resemblance to both Hoffman and Emerson arrangements. The Systems Division serves as the company's focal point for weapon system programs which require the skills of several of the more than 20 separate Bendix divisions. It performs the original systems analysis required for the proposal and the subsequent Phase I studies, making use of scientific talent available in its sister divisions.

When the program is ready to move into the prototype hardware development stage, the operating division which will contribute most to the program is designated as the Leader Division. The Leader Division then submits quota-



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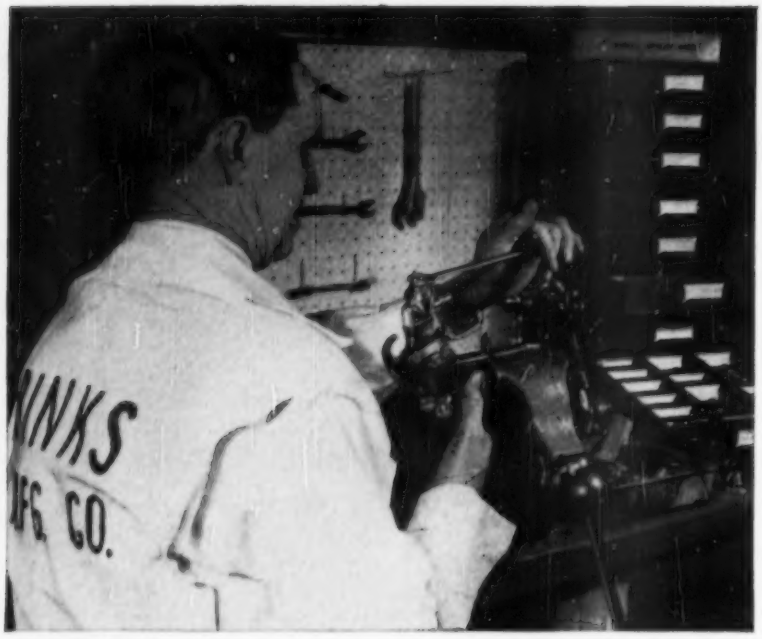

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tions and accepts the prime contract in behalf of Bendix Aviation.

The Systems Division then operates in an advisory capacity only, providing assistance to the Leader Division if required, according to Dr. Russell D. O'Neal, general manager of the Systems Division. This new operation now has approximately 40 scientists and expects to have 100 on its payroll by the end of the year, according to Dr. O'Neal.

Not The Only Way

The success which Emerson, Hoffman and their associates have in breaking into major weapon system programs will determine whether this pattern of operation will spread. However, there appear to be several alternatives for the medium-size company.

Dr. Cledo Brunetti, director of General Mills Mechanical Division, believes that a medium-size firm can obtain prime contracts for major weapon systems if it is willing to go all-out in its efforts.

A year ago, at the Dayton Aeronautical Electronics Conference, Brunetti warned of the plight of the medium-size company "with expert research talent and facilities but not of a depth sufficient to handle a major complete weapon system." Such companies, Brunetti warned, were being caught in the middle by weapon system prime contractors who were expanding their own facilities to move into new subsystem fields instead of using the existing capabilities of medium-size firms.

In the intervening year, General Mills has successfully competed with bigger firms and won two contracts for "major weapon systems," Brunetti says, although he declines to be more specific on security grounds. Brunetti attributes this success to the fact that General Mills went all-out to build a competent systems engineering team capable of coming up with proposals which the military found more attractive than those of the larger companies.

Won In Competition

Sanders Associates, a small but fast-growing avionics company, won a major subsystem contract in competition with Westinghouse Electric and Bell Telephone Laboratories on the basis of the superiority of its Phase I studies.

Another interesting trend is what might might be termed partnerships of opportunity, when one division of an industry giant may team up with one or more medium-size companies for a specific program in preference to working with its sister divisions. Sometimes such partnerships of opportunity bring together two firms which are competitors in another area or on another program. In the words of one industry official: "It's a crazy, mixed-up busi-

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The challenge of finding ways to handle these fuels is one which the Goodyear Aviation Products Division has met with singular success.

Drawing on experience which began when it developed the first successful bullet-sealing fuel tank back in 1920,

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utilizing test and research facilities unrivaled in the industry. Goodyear engineers have contributed importantly to the performance and range being achieved by a host of present-day missiles and piloted aircraft.

They have engineered new fuel cell materials which can withstand the deteriorating effect of these new propellants —cells which will not corrode or leak—cells so flexible they will fit through small openings to provide a maximum of available, precious space for propellant stowage.

And they have created these cells to withstand terrific vibration—safeguarded the fuel against contamination or interruption of the constant rate of vital fuel flow.

To get the most "git" to a go-getter you're planning today for tomorrow's defense—*get the benefits and skills that go with calling in the Goodyear man.* Contact: Goodyear, Aviation Products Division, Akron 16, Ohio, or Los Angeles 54, California.

Complete fuel test facilities at both locations.

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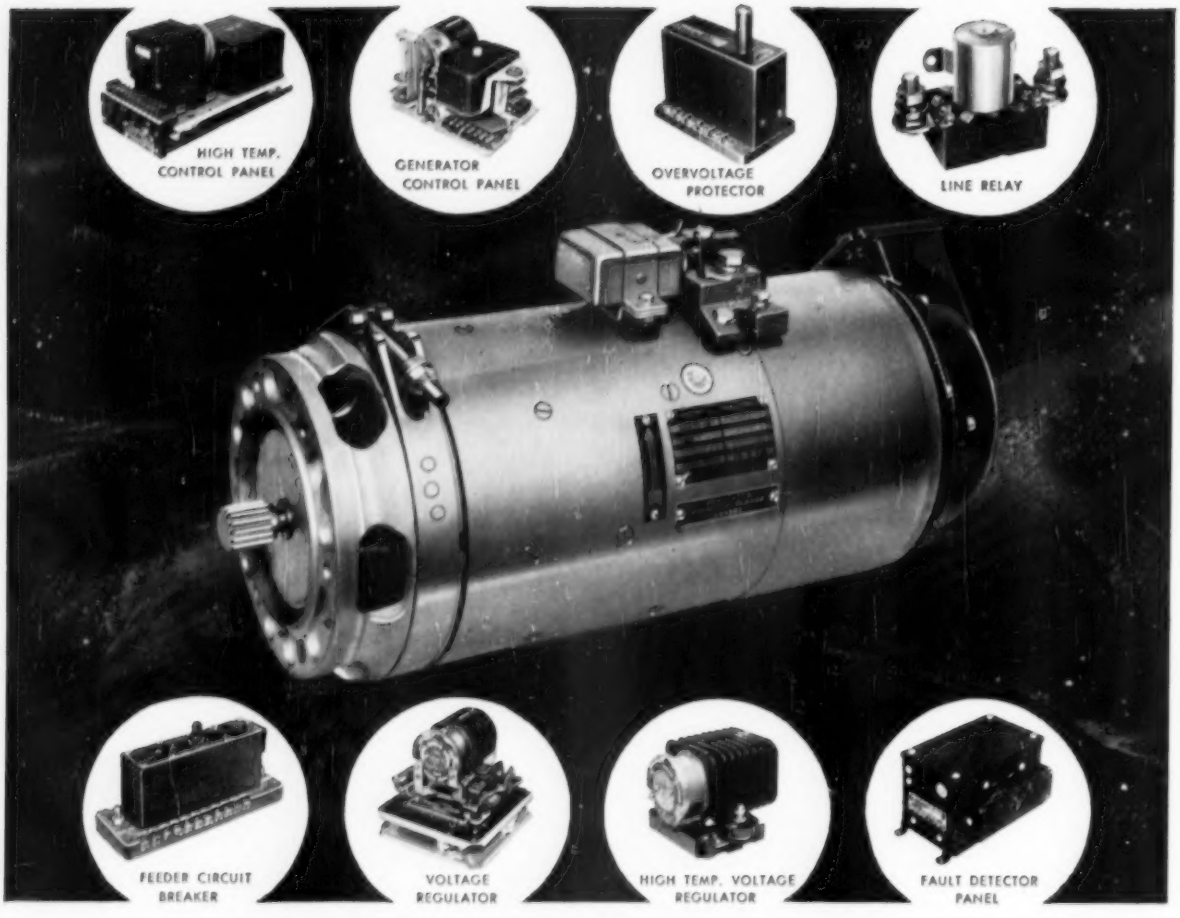

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30E16	100	2500-4500	50,000	40	52B6588
30B33*	100	4700-8000	35,000	28	MIL-S-9181
30E07	200	3350-8000	50,000	45	AN-3632
30E20	200—Class C 300—Class A	4000-8000	65,000	45	MA-1
30E02	300	3450-8500	25,000†	64	—
30B37	300—Class C 400—Class A	4000-8000	65,000	53	—
30E10	400	3100-8000	60,000	67	AN-3624
30B34	400	3100-8000	60,000	67	—
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Red Bank Division of Bendix AVIATION CORPORATION

A thousand products— a million ideas

ness." Here are a few examples:

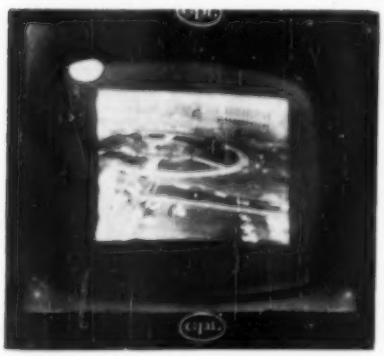
• **American Bosch Arma Corp.** teamed up with GE's Light Military Electronic Equipment Department (LMEED), which supplied the radar for Arma's B-52 tail defense system, to win out over a competing B-52 defense system proposed by GE's Aircraft Products Dept.

• **General Electric's LMEED** turned to a small outside company, Dynatrol, to provide the gyroscopics for its new Doppler auto-navigation system despite the fact that two other departments within GE are active in this field.

• **The Ramo-Wooldridge Corp.** is developing an airborne digital computer for Westinghouse Air Arm Division on one program, but joined General Electric's LMEED in a partnership with Douglas Aircraft Co. to submit a proposal for an airborne early warning system.

Meanwhile R-W will build radar for Avco's Crosley Division which is second source for the Arma B-52 tail defense system, while GE's LMEED supplys the radar to Arma.

In the fast moving avionics field, the only safe conclusion is that today's customer may be tomorrow's competitor and perhaps your partner the day after.



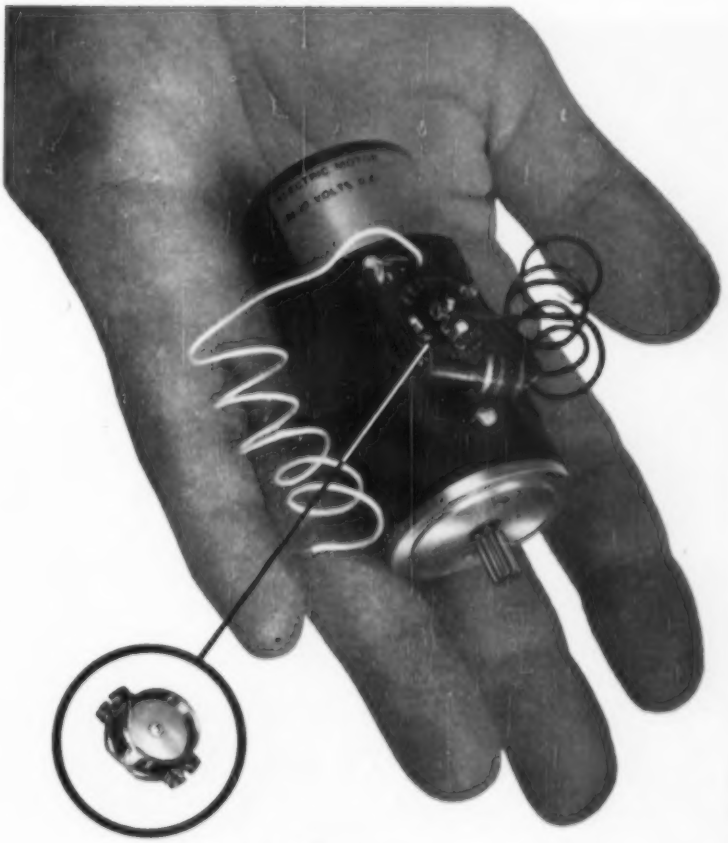
Technique Reduces Closed TV Costs

New technique which should reduce the cost of closed-circuit TV installations over distances of 10-15 miles by permitting use of narrow-band telephone lines instead of expensive video cables was reported recently by C. R. Krause of the Bell Telephone Co. of Pennsylvania.

The narrow-band tecchnique requires a bandwidth of only 250 kc., a 16:1 reduction over the 4,000 kc. normally required.

Yet it permits transmission of moving subject material and motion.

The system does not result in serious loss of definition or resolution. (See photo.) Compared to the 525 line picture sent 30 times per second in commercial TV, the new technique provides a 128-line picture 30 times per



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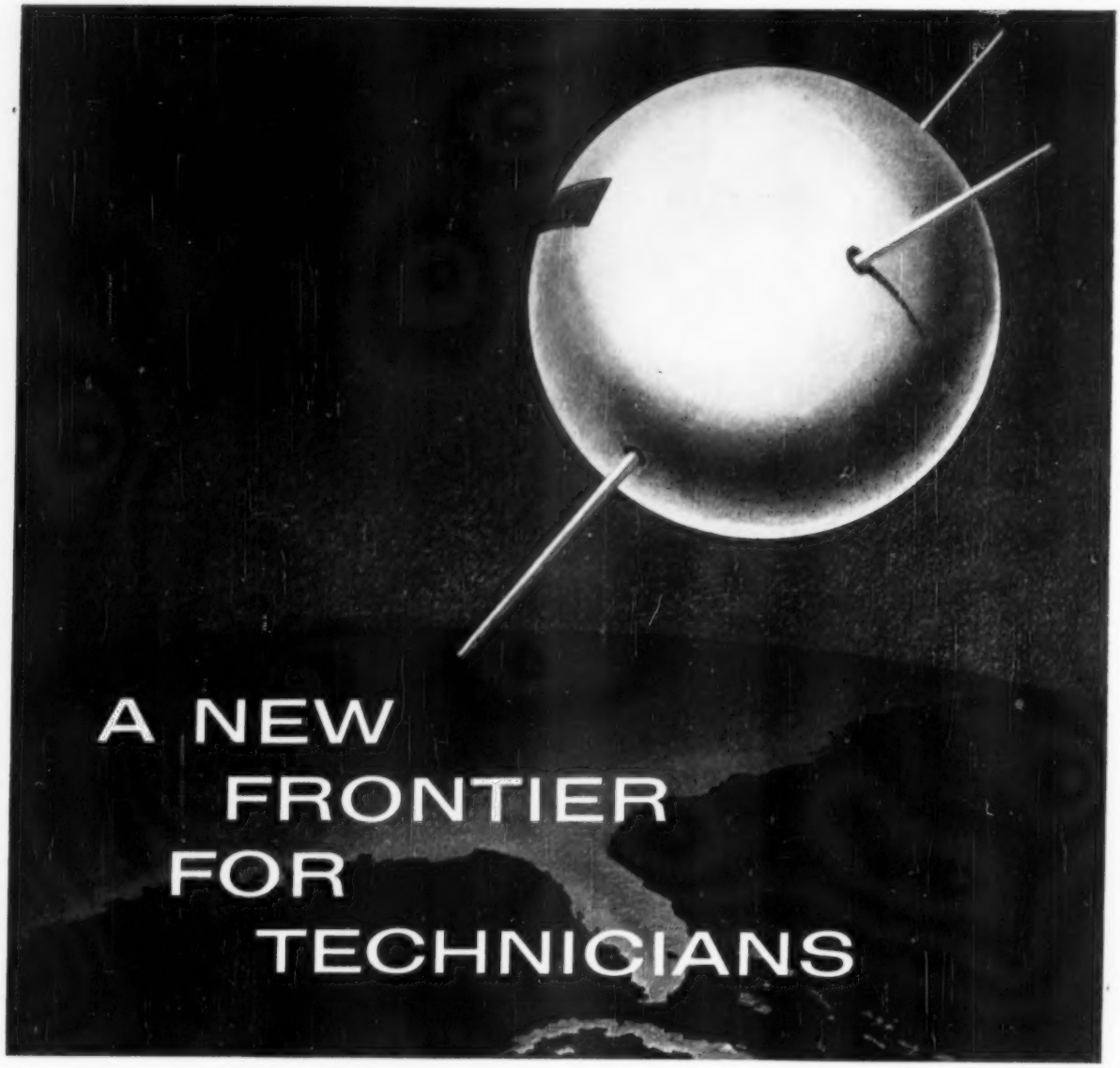

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second or a 185-line picture 15 times per second.

Regular telephone lines are used but special equipment is required to correct phase and attenuation distortion and intermediate amplifiers may be required in some cases.

General Precision Laboratory and Dage Television Division of Thompson Products, Inc., both makers of industrial TV equipment, cooperated with Bell Telephone in the development.

FILTER CENTER

▶ **Arinc Plans CSSB Tests**—Aeronautical Radio Inc. soon will modify one of its New York station HF transmitters to evaluate the Kahn compatible single sideband (CSSB) technique to determine whether it can be used with existing equipment. Arinc spokesman strongly denies published report that it has or intends to adopt CSSB and abandon suppressed carrier single sideband at this time.

▶ **Soviet Relay Network Analyzer**—Russians report they have designed machine which will automatically analyze relay network design to determine whether it can perform without logical contradictions. Machine was described in paper by Dr. Michael A. Gavrilov of the Moscow Academy of Sciences at recent symposium on switching theory at Harvard University. Machine described in Gavrilov's paper reportedly is more fully automatic and can handle more variables than any U. S. device now in existence. Russian's paper also revealed that Roumanian scientists published more papers on switching theory than any other country except for U. S. and U.S.S.R.

▶ **Transistor Decline?**—Transistors and magnetic amplifiers, which have almost completely replaced vacuum tubes in new digital computers, may eventually be replaced by new ferromagnetic film devices which can perform switching operations in one-thousandth of a microsecond. This prediction was made by Dr. Herbert Callen at the recent Harvard University symposium on switching theory.

▶ **CAA Buys Collins Microwave**—Civil Aeronautics Administration has placed $3.1 million order with Collins Radio Co. for 22 microwave link installations which will be used to remote radar information from new CAA long-range radar antennas to traffic control centers. The Collins equipment will operate at 7,000 mc. One link, between Houston, Tex., and traffic control center at San Antonio, will cover 200 miles and require six relay towers.

▶ **Transistor Sales Up**—Transistor manufacturers sold nearly three times as many units in the first two months of 1957 as they did in the same period last year. This year's sales reached 3.2 million units, compared with 1.2 million for January-February 1956; sales in dollars were $9.3 million versus $3.6 million in 1956.

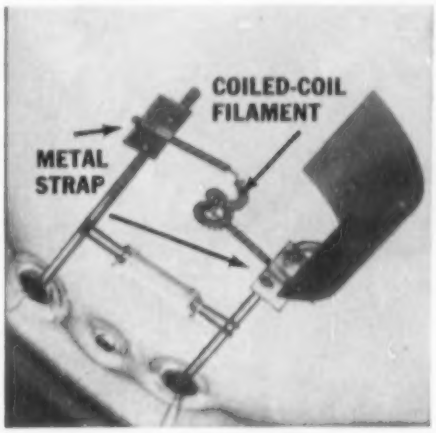
▶ **New Tube Handbook**—General Electric has issued new edition of its tube handbook, called "Essential Characteristics" which lists data on 1,593 types of tubes, including new military types. Handbook, priced at 75 cents, has plastic ring binder.

▶ **Navigation Meeting**—Annual Institute of Navigation meeting will be held June 27-29 in Washington D. C. at the Sheraton-Park Hotel. Presidential Assistant Edward P. Curtis will be the principal speaker at June 28 dinner.

▶ **Super-Sleuth**—Raytheon is now using new automatic X-ray detector to probe its subminiature tubes for hidden flaws. Machine can photograph up to 18,000 tubes per day.

▶ **Bendix Aboard Britannia**—Northeast Airlines has ordered Bendix Radio weather radar, VHF communication and navigation equipment, selective

G-E 600-watt Landing Lamp has...

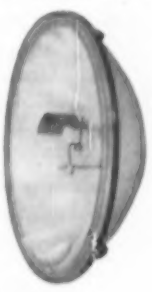


3 ADDED FEATURES AT NO ADDED COST!

LONGER SERVICE LIFE—G-E's new coiled-coil filament is rigid, needs no support wires to prevent sagging. This means there is no sawing action between support wires and the filament, eliminating this cause of premature lamp failure.

CONSTANT BEAM AIM—G-E Landing Lamp No. 4559 uses a new method of "anchoring" each filament end to a lead-in wire. This calls for precision spot-welding of two metal straps, insuring rigid support between the filament and the lead-in wires.

IMPROVED BEAM PATTERN—The precision design and location of the filament guarantee a circular beam pattern of more even intensity. Earlier types had "egg-shaped" beam patterns that were less uniform.



For more information on General Electric Landing Lamps, or any of the other General Electric Aircraft Lamps, call your G-E Lamp Distributor, or write: General Electric Co., Miniature Lamp Dept. AW-57, Nela Park, Cleveland 12, Ohio.

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Sardine Can

Transistorized UHF beacon transmitter has range of 25 miles and operates for 24 hours from power supply. Unit is constructed in sardine can, measuring only 2¾ x 4½ x 1 in., weighs 8 oz. Antenna, housed in hermetically sealed tube, is exploded into transmitting position by small gun powder charge. Beacon was developed and produced by Electronics division of Fairchild Controls Corp.

calling, automatic direction finders and passenger address amplifiers for installation on its five new turboprop Britannias.

▶ **New Business**—Following companies report receipt of major new contracts:

• **Summers Gyroscope Co.**, Santa Monica, Calif. has received $1 million contract from Douglas Aircraft Corp. for vertical gyro indicator systems.

• **General Electric's Technical Products Dept.**, Syracuse, N. Y. has received Army Signal Corps contract of undisclosed size for a closed-circuit color TV system to be installed at the USAF Missile Test Center, Cape Canaveral, Fla.

• **Burroughs Corp.**, Detroit, has been awarded a $1.8 million contract for data processing and transmitting equipment for the SAGE air defense system by the Air Materiel Command. This makes total of more than $23 million in SAGE equipment awarded to Burroughs.

• **General Electric's Aircraft Products Dept.**, Johnson City, N. Y., will build $2.3 million in fighter-bomber fire control equipment under a new Air Materiel Command contract.

• **General Electric's Light Military Electronic Equipment Dept.**, Utica, N. Y., has received $42 million Air Force contract for advanced electronic countermeasures equipment, superseding and increasing an earlier $22 million contract from the Air Materiel Command.

Aerodynamicist

The Electronics Division of Curtiss-Wright Corporation has an excellent opening in New Jersey for an aerodynamicist to analyze flight performance characteristics of all types of aircraft, using theoretical design and flight test data. The results of these data are used as a basis for design of large scale analog systems as used in flight simulation. B.S. or M.S. in Ae. E. and 1-6 years' experience in performance analysis and stability and control with airframe manufacturer.

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11

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COX & STEVENS ELECTRONIC SCALES DIV.

Revere CORPORATION OF AMERICA

WALLINGFORD, CONNECTICUT A Subsidiary of Neptune Meter Company

Expansions, Changes In Avionics Industry

Servomechanisms, Inc., has established new Vacuum Film Products Division in El Segundo, Calif., which will develop and manufacture components using vacuum film deposition techniques. New division will be headed by David W. Moore.

Other recently announced expansions and changes in the avionics industry include:

• **General Instrument Corp.** has purchased **Radio Receptor Co.**, Brooklyn, maker of rectifiers and avionics equipment. The purchase is General Instrument's third acquisition in the past year.

• **U. S. Industries, Inc.**, New York, will acquire the outstanding stock of **Kett Corp.**, Cincinnati, which makes infrared countermeasures and other avionic devices. Karl Schakel, president and founder of Kett, will continue to head the new acquisition.

• **General Electric's Missile and Ordnance Systems Dept.** has completed $1½ million Air Force facility for assembly and testing of precision radar antennas atop a mountain in the Berkshires, near Hancock, Mass.

• **American Electronics, Inc.**, Los Angeles, has formed new division to be known as **American Laboratories** which will provide complete environmental test facilities and services for contracting to avionic equipment and component manufacturers. American Laboratories will be housed in new 11,000 sq. ft. facility at Fullerton, Calif.

• **General Atronics Corp.**, consulting and development firm specializing in electronics and applied mathematics, has moved into new quarters at One Bala Ave., Bala-Cynwyd, Penna.

• **Computing Devices of Canada, Ltd.**, will handle **Bendix Radio's** avionics line in Canada following new agreement transferring sales responsibility from Aviation Electric Ltd., which will continue to handle products of other Bendix divisions, including Eclipse-Pioneer.

• **Consolidated Electrodynamics Corp.** has broken ground for two 57,500 sq. ft. office and laboratory buildings in Monrovia, Calif. to house its Transducer and Systems Divisions. Completion is expected by October.

• **Summers Gyroscope Co.**, Santa Monica, Calif., has broken ground for new $1½ million, 103,000 sq. ft. plant and general offices at Broadway and 26th St. in Santa Monica. New facility

will raise company total to over 200,000 sq. ft.

• **Consolidated Electrodynamics Corp.,** Pasadena, will purchase assets of its neighbor, **William Miller Instruments, Inc.,** which will be operated as the Miller division. Miller's two subsidiaries, Transformer Engineers and Pacific Transformer are not included in the deal. Edwin M. Graham, former Miller executive vice president, is named general manager.

• **Baldwin-Lima-Hamilton's Electronics and Instrumentation division** has formed new Dynamics Products group at Waltham, Mass., to design and development equipment for measuring shock, vibration and acceleration. New group will be headed by Alexander J. Yorgiadis, chief engineer and A. U. Kutsay, assistant chief engineer.

• **Friez Instrument Division of Bendix Aviation** will add 66,000 sq. ft. to its present 100,000 sq. ft. Baltimore facility. Occupancy is slated for December.

• **North American Aviation's** Autonetics division has opened an eastern office in Washington, D. C., in the Cafritz Building. New office is headed by Norman P. Hays, formerly a member of the Armament Laboratory at Wright Air Development Center.

• **Consolidated Electronics Industries Corp.,** New York, has received stockholders approval which could lead to

Airport Seeing Eye

Closed-circuit TV camera, designed for outdoor use at airports for runway surveillance, is protected from elements, has motor driven windshield wiper. Unit is part of new line of closed-circuit TV equipment developed by Philco Corp. TV cameras can be focused, tilted, panned and their aperture openings adjusted by remote control.

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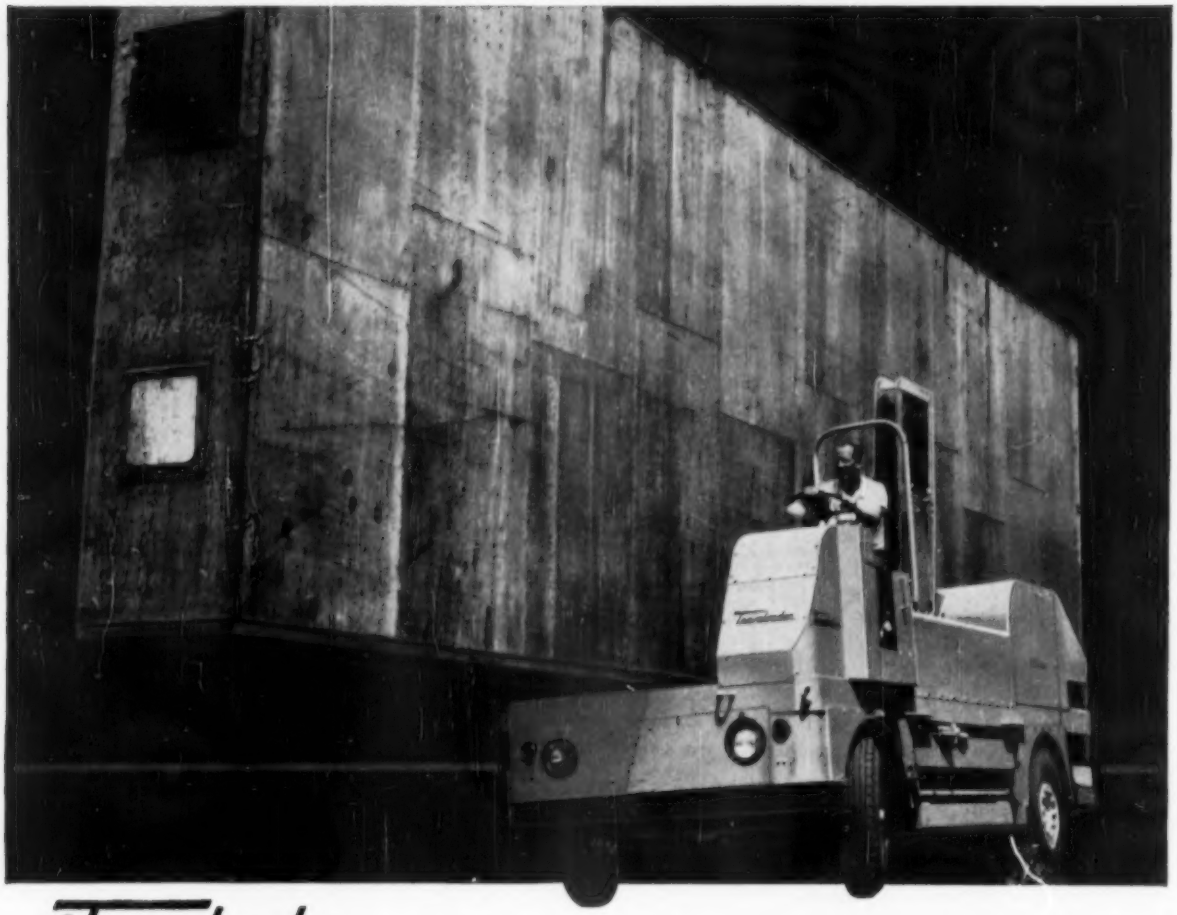

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The labor, time and money-saving role played by industrial trucks throughout industry has long been recognized. But until now, there were no available methods or equipment for satisfactorily applying them to extremely long, bulky or awkward loads. Now comes the Baker TRAVELOADER, designed for just this purpose. It is ideal for jobs like the one illustrated—where it is handling airplane wing sections created for export.

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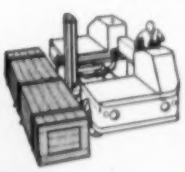

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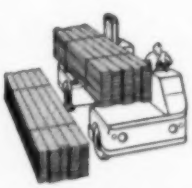

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eventual acquisition of the Sessions Clock Co., Forestville, Conn. CEIC will provide loans and management assistance to Sessions through a subsidiary and obtain option to buy substantially all of Session's assets at any time up to June 30, 1962.

• **Servomechanisms, Inc.,** Westbury, N. Y., has broken ground for new 55,000 sq. ft. facility also in Westbury on West John St., for design and manufacture of avionics control equipment.

• **Avionics Liaison** will act as sales representatives in the Pacific Northwest for Dynamics Research Associates, Ferguson, Mo., a division of Universal Match Corp., and makers of magnetic amplifiers.

• **Gulton Industries, Inc.,** Metuchen, N. J., has formed Nuclear Instrumentation Division in Albuquerque, N. M., to specialize in nuclear instrumentation and telemetering systems. Division is headed by Burt J. Bittner, formerly of the Sandia Corp.

• **Ohmite Manufacturing Co.,** Skokie, Ill., maker of resistors and other components, has opened New York area office at 318 Bergen Blvd., Palisades Park, N. J. Office is headed by Edward A. Rehe.

ICBM Data Facility

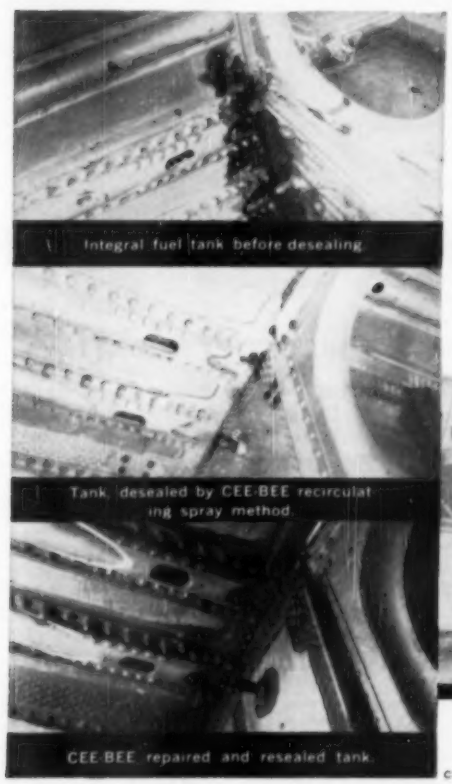
New data reduction center at The Ramo-Wooldridge Corp., Los Angeles, will be used to speed conversion of telemetered test data for its Guided Missile Research Division which has systems engineering responsibility for the Air Force ballistic missile programs. Facility was designed by R-W's Electronic Instrumentation division.

• **Tektronix, Inc.,** Portland, Ore., maker of precision oscilloscopes, has opened new field engineering office in New York area at 840 Willis Ave., Albertson, N. Y.

• **Universal Transistor Products Corp.** is new name of the former **Universal Atomics Corp.,** Westbury, N. Y. Company's electronic and nucleonic instruments operation becomes its Universal Atomics division.

• **J. B. Rea Co.,** Santa Monica, Calif. has expanded its computing service facilities with an adidtional $300,000 in equipment, including a new Electronic Associates analog computer.

• **Hoffman Laboratories, Inc.,** Los Angeles will increase size of its new R & D laboratories by 50% over original plans, to provide an additional 20,000 sq. ft. Facility is slated for completion in July.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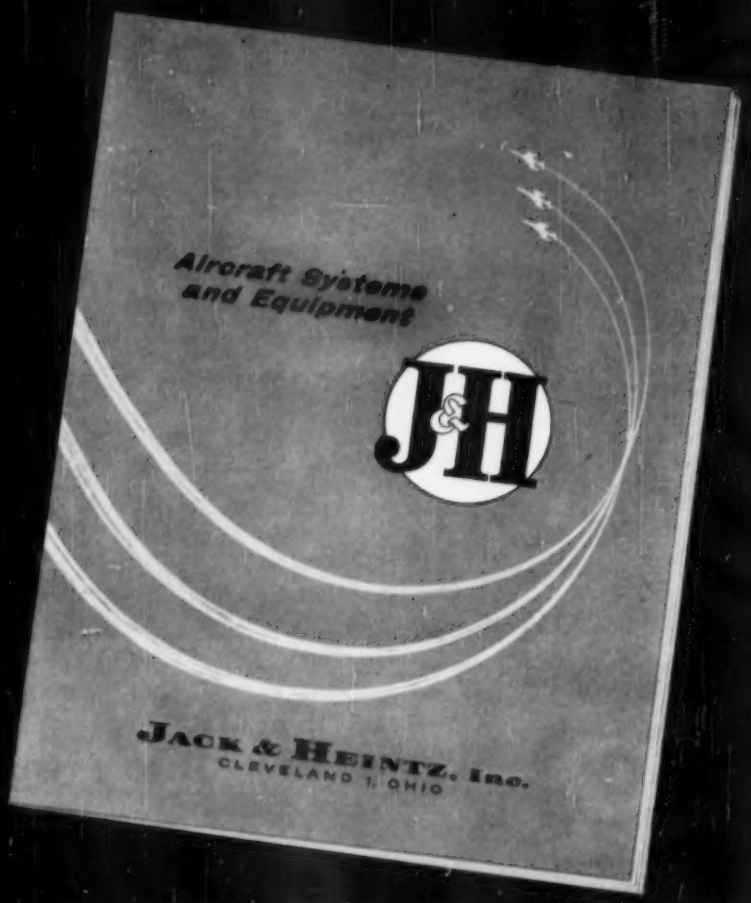

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lower scales, 2 megohms on upper scale. Unit operates from 115 v., 60 cps., weighs 5 lb. Price: $170. Paul Industries, P. O. Box 3474, Glendale, Calif.

• **Infrared radiation source,** Model CPD-3, provides stable, accurately controlled black body radiation over broad range of temperatures from ambient plus 10C to 500C. Unit measures 7¼ x 9 x 10¾ in. Haller, Raymond & Brown, Inc., State College, Pa.

• **Low-frequency waveform generator,** Type LF-51, can generate sine waves at frequency of 0.0005 to 500 cps. with accuracy of within 2%, pulses whose duration can be varied from 1 millisecond to 1,000 seconds, with rise-time less than 5 microseconds. Ramp functions can be generated with 1% linearity over range of 1 millisecond to 16 minutes. Output can be continuously varied between 100 microvolts and 150 volts. British Industries Corp., 80 Shore Road, Port Washington, N. Y.

• **UHF millivoltmeter,** Type FT-URV for calibrating signal generators and measuring minute voltage levels, has sensitivity of 3 mv. and is usable from 1 kc. to 2,000 mc. when used with accessory insertion unit. Voltage range is 3 mv. to 10 volts. Federal Telephone & Radio Co., 100 Kingsland Rd., Clifton, N. J.

• **Sweep oscillator,** Model DY-2200, covers frequency range of 5 to 5,000 cps. in one continuous band, eliminating switching transients and dial discontinuities. Dial is directly calibrated in true log scale. Amplitude of signal output is variable in 10 steps. Dynac, Inc., 395 Page Mill Road, Palo Alto, Calif.

• **High-power broadband sweep oscillator,** Model ESG, covers band of 1 to 15 kmc., provides power output of 10 mw. to 1 watt using seven interchangeable microwave oscillator units. Polarad Electronics Corp., 43-20 34th St., Long Island City 1, N. Y.

Computers & Data Processing

• **Transistorized digital computer building-blocks,** new line of logical circuits for asynchronous digital computers and data processing equipment, are designed for d.c. operation in the 0 to 100 kc. range. The new M-Pacs are available in following standard packages: flip-flops, emitter followers, pulse amplifiers, diode

gates and buffers, inverter amplifiers, one-shot multivibrators, variable frequency blocking oscillators and crystal-controlled square-wave oscillators. Units are mounted on 2¼ x 3¼ in. epoxy-glass printed circuit card. Computer Control Co., Inc., Wellesley 57, Mass.

• **Transistor-core logical element,** consisting of one transistor and one rectangular hysteresis loop magnetic core, comes in two different models, one rated for operating at 0 to 50,000 bits per second, the other 0 to 100,000 bits per second. As many as 120 such units can be packaged per square foot of panel space. Line of compatible drivers, input and output units are also available. Mack Electronics, 40 Leon St., Boston

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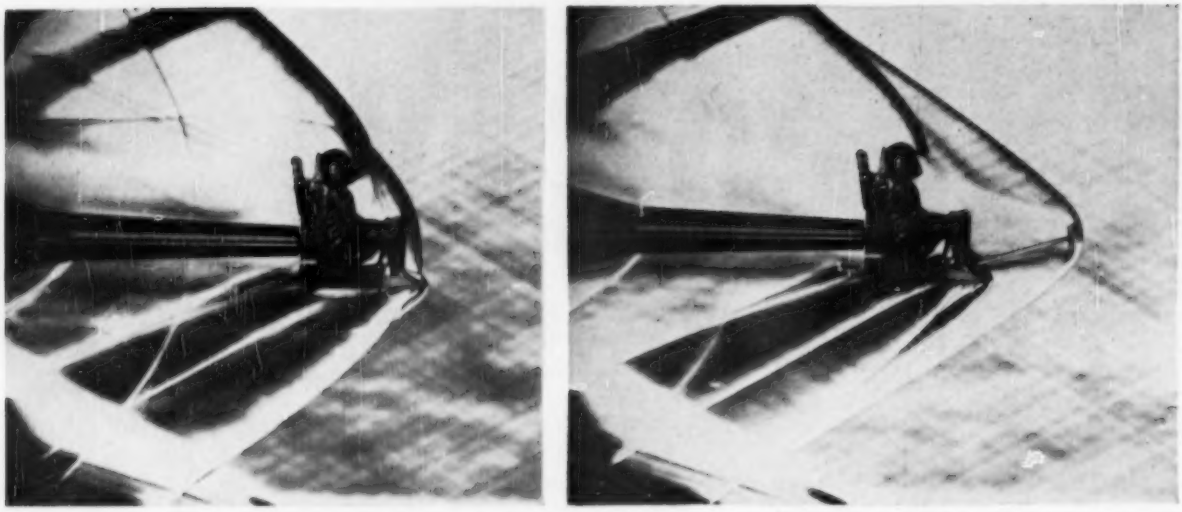


PROTECTION from skip flow generator is demonstrated by wind tunnel tests. Seat (left) is unguarded; the other (right) has device.

Crash Program Seeks Ejector for High

By George L. Christian

Denver—Crash program to remedy a deadly deficiency—subsonic escape systems in supersonic aircraft—is beginning to pay off for Air Force and Navy.

To make supersonic ejection consistently possible, the U. S. aviation industry has come up with two new seat configuration concepts, each different from the other:

- **Skip flow generator**—trapezoidal air flow diverter mounted on a boom in front of the pilot. This concept is used with Lockheed's downward ejecting D-seat.
- **Bobsled or B-seat**—upward ejection system which rotates the pilot 90 deg. before separating from the plane so that he slams into the air stream in a feet forward position with the seat bottom protecting him.

Third System

A third escape system, called the A-seat, also is being developed. This seat combines the Lockheed type of skip flow generator with a conventionally upward-ejected seat.

Dual purpose of the new supersonic escape systems is to avoid fatal deceleration and tumbling experienced at supersonic escape speeds with conventional ejection seat.

Corollary aim is to keep the crew member's personal equipment from being ripped off by air blast.

All three configurations have true supersonic capabilities. The Lockheed D-seat is rapidly taking shape at Stanley Aviation Corporation's new plant here. Scale models of the other two seats are undergoing comprehensive tests.

The D-seats are expected to be available for production F-104As before the end of the year and can be retrofitted into F-104As now flying. Of three seats already built, two have been test fired from supersonic slods at Hurricane Mesa (AW Feb. 25, p. 347) with excellent results.

Full-scale models of both B- and A-seats will soon be tested at the same facility.

Stanley has also completed a prototype cockpit escape capsule. It was built and will be tested under a contract from USAF's Wright Air Development Center.

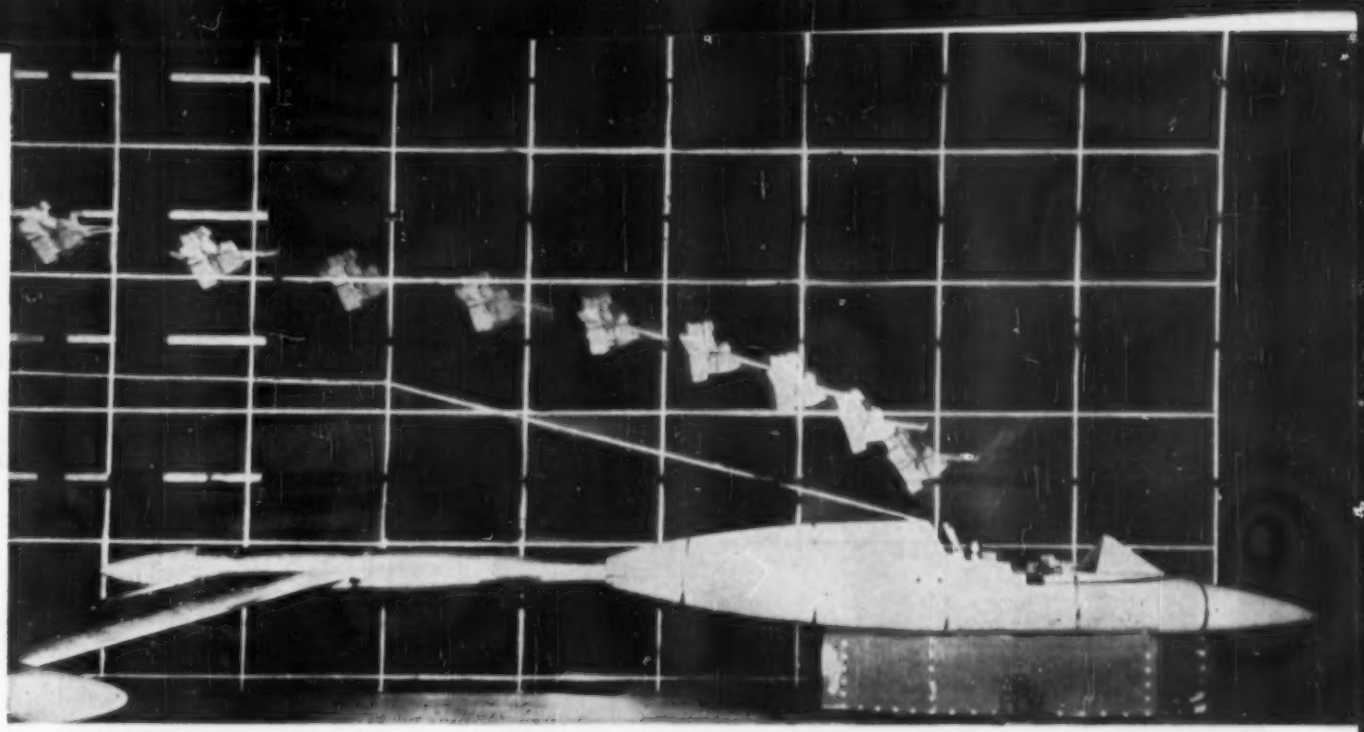
The ejection seats represent the first pieces of hardware resulting from an industry-wide program to develop escape systems with true supersonic capabilities. Convair was assigned by USAF's Air Research and Development Command the responsibility of coordinating development of an upward pilot escape system. Lockheed was assigned a parallel responsibility for development of a downward escape system.

Contracts resulted from the military's realization of the very real deficiencies of the escape systems used in the growing number of supersonic aircraft now operating. The existing seats' limitations are approximately 600 kt. and 50,000 ft., well below speed and altitude capabilities of many types of Air Force and Navy aircraft now flying in squadron strength.

Dilemma facing the services seven months ago was whether a substantial

MODELS of B-seat depict its three phases of operation, first in normal position . . .

. . . **EJECTION** begins with raising of leg stirrups, and seat, which "folds up" pilot . . .



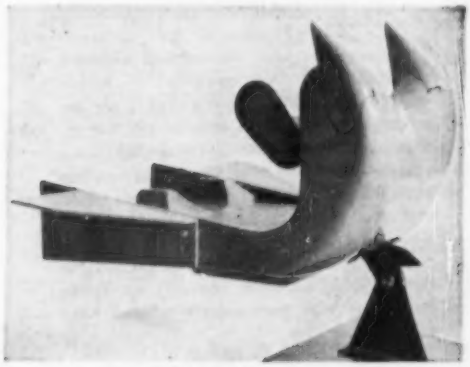
TIME-LAPSE photos of ejection of Lockheed seat type from model show its stability after leaving aircraft.

Mach Escape

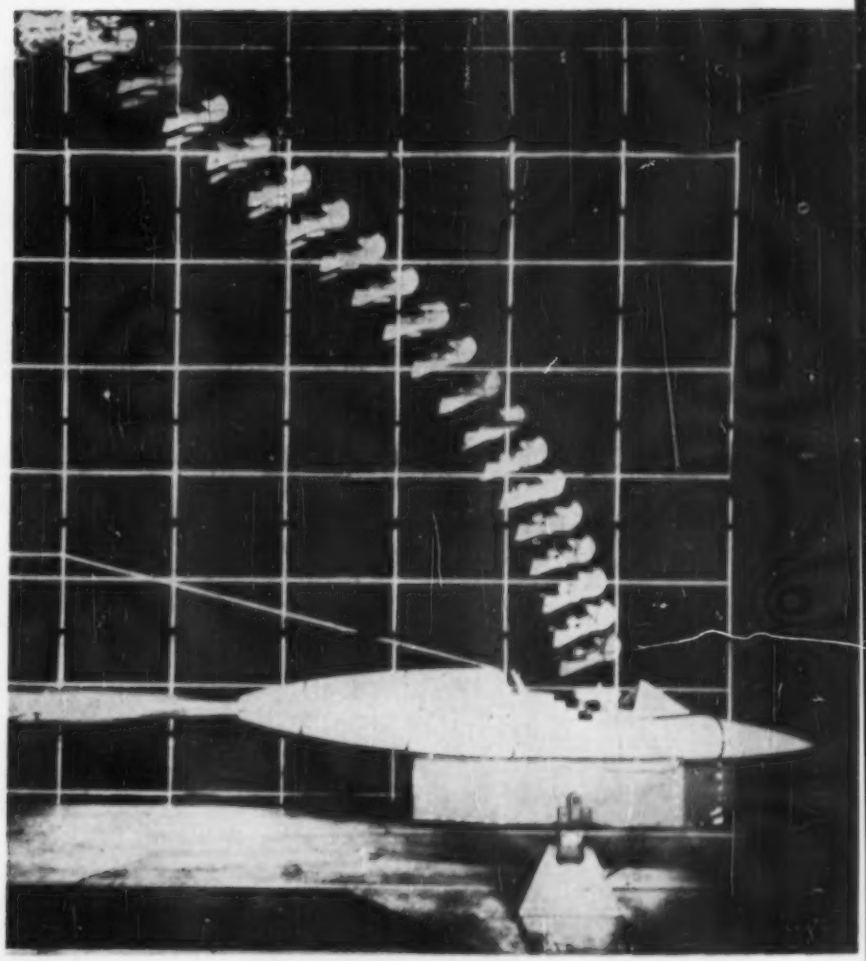
improvement could be made over the existing subsonic—or at best transonic—seat, and how much effort in time and money the project might require.

Crash Program

USAF last October decided to set up a crash program to lick the problem fast. To implement the idea, the Air Force formed the Industry Crew Escape Systems Committee, composed of eight major airframe manufacturers. Attending the ICESC meetings, scheduled quarterly or oftener, are 12 other organizations. They include other airframe makers, seat and escape capsule manufacturers, a research group and Navy's BuAer. Chairmanship of ICESC alternates between Lockheed and Convair. A group of five USAF technical specialists and engineers, called the Air



. . . **LEAVING** the aircraft, seat has rotated 90 deg. and stabilizing fins have unfolded.



B-SEAT ejection photographed by time lapse method also show seat stability. Differing speeds of two sequences account for path variation, not seat qualities themselves.

Force Coordinating Committee, sits in on all ICESC functions to evaluate its work.

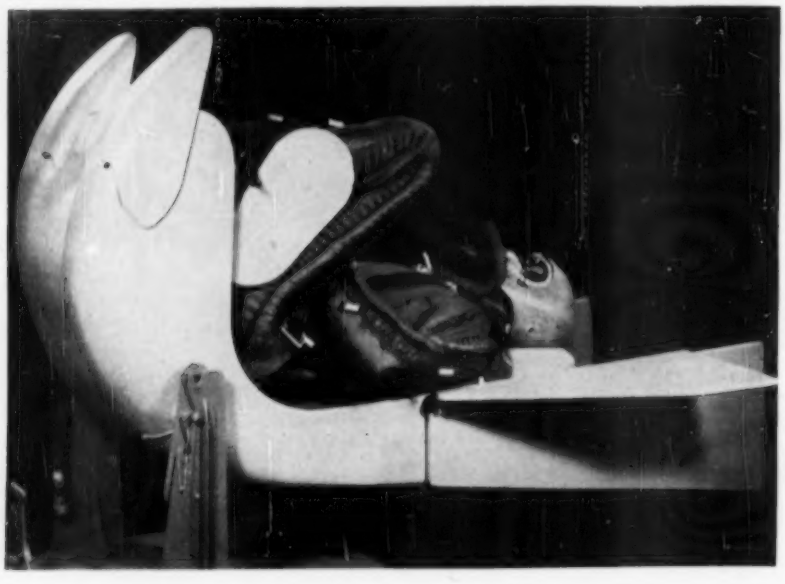
The coordinating committee comprises John Trenholm, Air Research & Development Command and Peter di Salvo, Air Materiel Command, co-chairmen, and these members from WADC: Lt. Col. K. F. Troup, Aero Medical Laboratory; Maj. A. G. Mayse, Crew Station Office; and A. B. Nutt, Aircraft Laboratory.

"So far, there has been no problem of the ICESC making progress," Trenholm told AVIATION WEEK. "The services are certainly getting their money's worth." There are no "proprietary ideas" in the group, Trenholm said, and everything is available to everybody. ICESC is achieving substantial results in "an unbelievably short time," he added.

Wright Field officials note these highlights of ejection developments in ICESC's work and related test programs:

• **Future upward ejection seats** (the Lockheed D-seat may be the first and last production downward seat) must have zero altitude capability. The new rocket-tube, or canted rocket ejection seat (AW Nov. 12, p. 71), is expected

FULL SCALE B-seat mockup is shown with a man seated in it. In escape, seat, stirrups fold up, raising pilot's knees toward his chest. Seat rotates 90 deg. and fins emerge.



Aeroquip

Engineering Notes

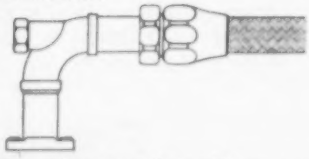
B. A. MAIN, JR.

The advertisement at the right says you can save money if you buy Aeroquip Hose Lines. Let's see how right this statement is.

Consider the production line along which an aircraft engine or airframe is assembled. Your purchasing department will buy anywhere from three to six months' supply of hose lines to feed the production line. In this day and age of rapid change, it is pretty much a foregone conclusion that some engineering revision or modification will be required on the engine or airframe.

Where these changes affect the hose lines, if you purchased Aeroquip Hose Lines originally, the detachable, reusable hose fittings always used by Aeroquip make it possible to rework the hose lines. Should the hose lines need to be shortened, it is simple to remove one of the hose fittings, cut the hose to the proper length and re-assemble. If the hose line needs to be longer, a new piece of hose can be installed easily, using the same fittings over again. This can be done in your plant by your own people, or if our costs are lower —as they might be if the quantity of lines to be reworked is large—you can have them reworked by us.

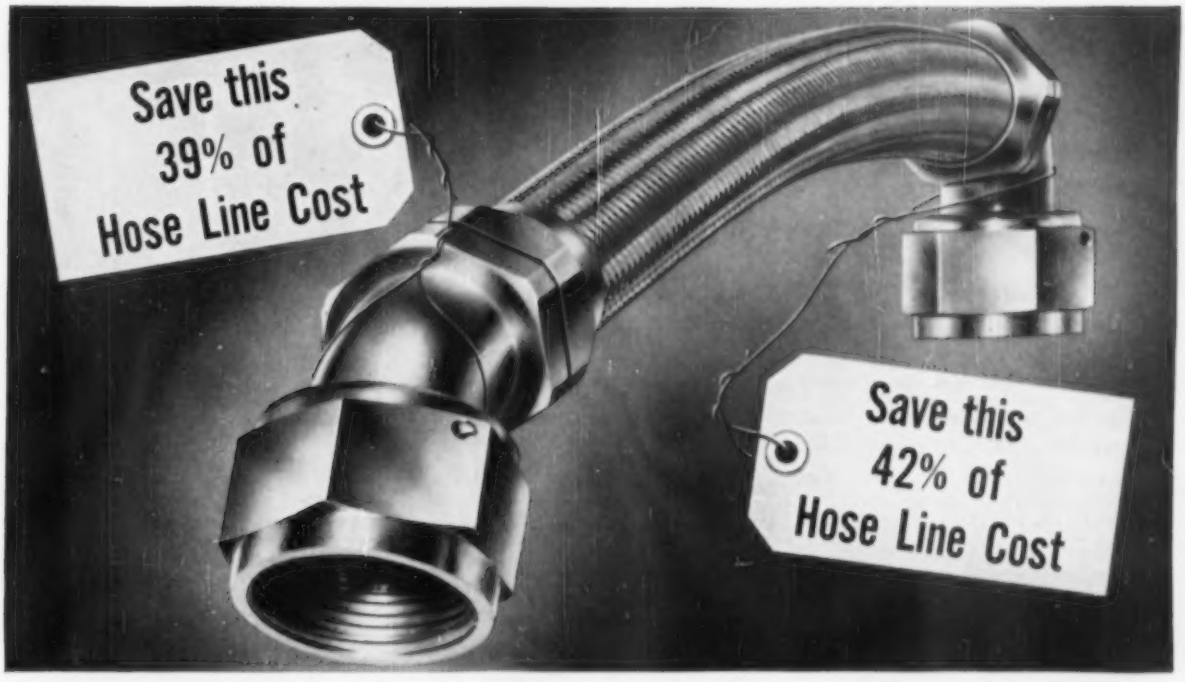
The advertisement shows the proportion of cost of an elbow-type hose fitting to the cost of the hose assembly. This proportion varies with the complexity required in the hose fitting. A fitting composed of complicated bends of rigid tubing, with perhaps one or two bosses welded into it, like the one illustrated below, may run several times the cost of the hose itself. In any case, simple or complicated, the cost of the fittings will usually exceed the cost of the hose.



If you purchase hose lines with permanently attached hose fittings, no rework is possible and you must pay at least double for the privilege of making an engineering change. If you purchase Aeroquip Teflon Hose Lines you can, as the ad says, save money—often more than half of what new hose lines would cost you. And, you can buy the Aeroquip Hose Line with its Detachable, Reusable "*super gem*" Hose Fittings at prices competitive with the price you pay for Teflon hose lines with permanently affixed hose fittings.

B. A. Main Jr.

VICE PRESIDENT, ENGINEERING
AEROQUIP CORPORATION



Aeroquip Teflon* Hose Lines Cost Less

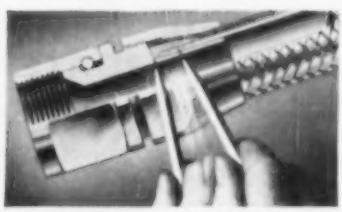
BECAUSE "*super gem*" FITTINGS ARE REUSABLE

The true cost of a hose line cannot be determined by the purchase price alone. Teflon hose lines with permanent-type, swaged-on fittings are priced competitively with Aeroquip Teflon Hose Lines, but Aeroquip "*super gem*" Fittings are reusable and can be salvaged. And the fittings are the most expensive part of any hose line!

During production, engineering changes frequently call for alterations of fluid-carrying lines. Because it had purchased hose lines with permanently attached fittings, one aircraft company was forced to scrap more than $100,000 worth of Teflon hose lines due to a single engineering change. With Aeroquip Teflon Hose Lines, the "*super gem*" Fittings could have been salvaged and reused with savings of thousands of dollars.

Not only do "*super gem*" Fittings give Aeroquip Teflon Hose Lines cost-cutting advantages, they assure the ONLY leakproof, ageless assembly of fitting and Teflon hose. Want more information? Mail the coupon below.

Aeroquip 666 Teflon Hose and "*super gem*" Fittings can be assembled by hand in a few minutes. No expensive swaging machine is necessary. A wrench and a vise do a perfect job.



Cutaway of "*super gem*" Fitting with metal-to-metal line seal pointed out at left and lip seal at right. Together, these features assure permanent protection against leakage.

Aeroquip Corporation,
Jackson, Michigan

Gentlemen:

Please send me your Bulletin AEB-13 on reusable "*super gem*" Fittings and 666 Teflon Hose.

Name_____

Title_____

Company_____

Address_____

City_____ Zone____ State_____

"*super gem*" is an Aeroquip Trademark. *DuPont trade name for its Tetrafluoroethylene resin.

Aeroquip

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AEROQUIP CORPORATION, JACKSON, MICHIGAN
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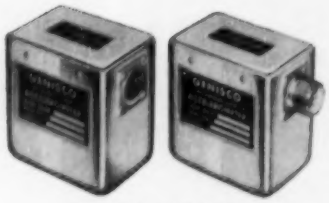
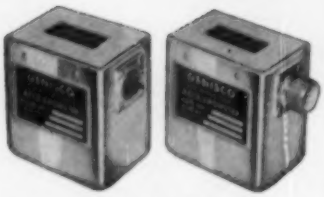
AEROQUIP (CANADA) LTD., TORONTO 10, ONTARIO



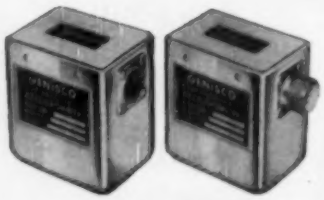
Model GLH

A rugged magnetically damped instrument with low natural frequencies for low range. High-quantity production assures good price and delivery schedules. Available in ranges from ±1 G to ±30 G.



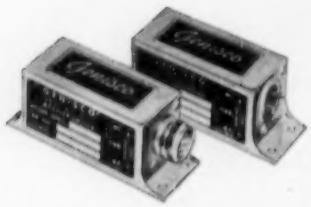
Model DDL

Magnetically damped low-range instrument available in ranges from ±1 G to ±30 G. Ultra-sensitive models supplied as low as ±0.1 G. Certified to MIL-E-5400 and MIL-E-5272A. Especially good in severe shock and vibration applications. An acceleration-sensitive switch version of the DDL is designated as the Model DDS.



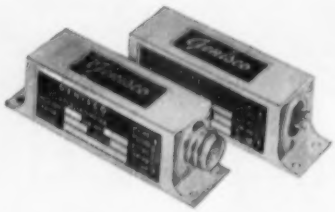
Model GAL

Incorporates a variable transformer a-c output with the magnetically damped sensory mechanism of the proven Models DDL and GLH. Superior reliability, life, resolution, and sensitivity. Available in ranges from ±1 G to ±30 G. Range as low as ±0.1 G also obtainable.



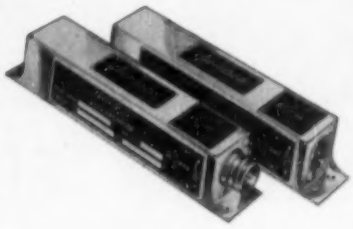
Model GMO

A rugged, miniature, viscous-damped instrument with ranges from ±2 G to ±30 G. Unbalanced-range instruments also available. Medium high natural frequencies.



Model GMT

Basically a Model GMO with internal thermostat-operated heater, assuring maximum environmental stability within the instrument. Damping remains constant with change in ambient temperature.



Model GDM

Miniature double-potentiometer instrument capable of sensing lateral acceleration in two mutually perpendicular planes (e.g., pitch and yaw). Ideally suited for missile and high-speed aircraft flight control systems.

NEW! GENISCO ACCELEROMETERS NOW GOLD PLATED FOR GREATER RELIABILITY

CASES GOLD PLATED INSIDE AND OUT—This new trend in instrument plating has two important advantages over tin plating or fusing. Being the least active metal, gold prevents the formation of crystalline "whiskers" inside the case which could reduce performance and even cause malfunction. Gold-plating also assures positive protection against corrosion to the exterior of the case and, because of its excellent solderability, makes possible a more reliable hermetic seal. The new gold plating is available on *all* models at *no extra cost.*

Descriptive data sheets available on all models.
Please send request on company letterhead.

Genisco INCORPORATED

2233 Federal Avenue
Los Angeles 64, California

CATAPULT used to develop D-seat tossed 1/10 scale models into a butterfly net.

to be of great help in meeting this requirement. It shoots crew members high enough into the air to make zero altitude escape feasible. The rocket-tube concept was developed by The Fulton Irgon Corporation, Bernardsville, N. J., and Talco Engineering Co., Inc., Hamden, Conn.

• **Work will soon start,** either at Lockheed or North American, on a "Convair Type-A" seat which ejects conventionally upwards. Goal is to avoid complication of the B-seat, which rotates the pilot-and-seat backwards 90 deg. during the ejection cycle. Lockheed's skip flow generator, key component of its successful D-seat, may be integrated with the A-seat to protect the pilot from air blast. If such a seat can be successfully developed, it will have the added advantage of being much easier to retrofit into existing supersonic aircraft than the more complicated, bulkier B-seat.

• **Lockheed's D-seat** has been successfully ejected from high speed sleds at Mach 1.3 at sea level (equivalent to Mach 2 at 35,000 ft.). According to witnesses, "it was a good, stable little flying machine." Dynamic pressure on the seat was an acceptable 2,500 psf.

• **High speed sled tests** with anthropomorphic dummies show that standard MC-4 partial pressure suits are satisfactory for supersonic bailout. However, trouble has been experienced with the standard MA-2 Air Force helmet. Supersonic air blasts wrench the helmets off dummies' heads. Since seat design is predicated on use of a helmet, the Air Force may have to make a sudden swing over to the up-coming MA-3 helmet if the MA-2 proves conclusively to be unsatisfactory.

• **Effort now** is principally to keep pilot alive during supersonic ejection. Inevitably, he will be subjected to forces which come very close to his physical tolerance limits. He can expect to be banged around and bruised. However, seat design will keep him from sustaining such non-fatal injuries as severe strains or broken bones. He will be

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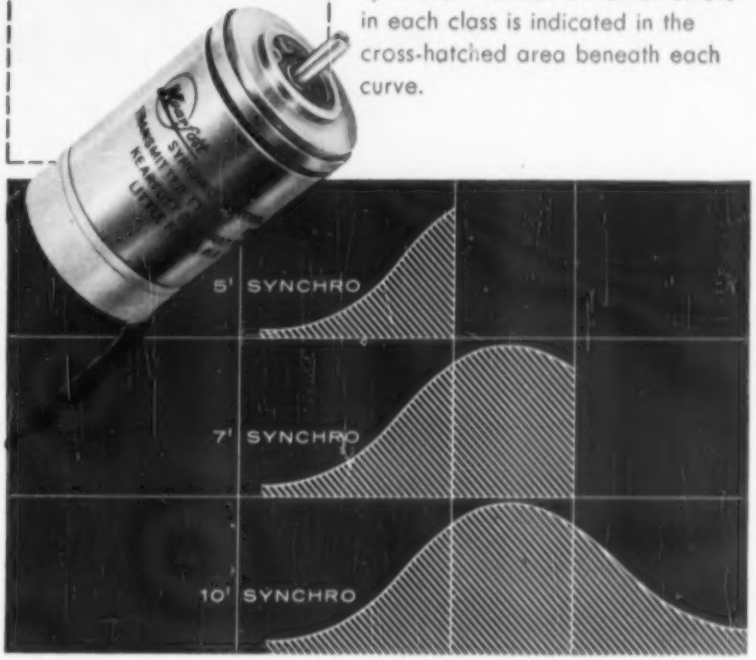

Kearfott Series R900 Synchros are characterized by high accuracy, corrosion resistance and new high temperature stability. Units available for early delivery.

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SCHEDULE THE AVIATION WEEK

Need for Specialized Research and Development Information

Manufacturers are busy broadening their research and development activities. They recognize that their competitive position depends on the ability to compete in the urgent quest for new basic scientific knowledge in such diverse fields as geophysics, aerothermodynamics, metallurgy, human factors and aerothermochemistry, etc. Because of the highly specialized sciences and technical fields concerned, manufacturers must often obtain research and development assistance from outside sources – government, university, scientific foundation, foreign and other manufacturers. In a sense, research and development has become a *unique commodity that is produced, bought and sold.*

Expansion of research and development procurement activities has brought the need for a Guide which will increase the understanding of procurement procedures and available facilities and capabilities. To satisfy this need, the Research and Development Edition, an outgrowth of editorial pioneering in this field as outlined later in this announcement, will provide the following specialized research and development information:

INDUSTRY

Industry's vital and rapidly increasing role in research and development will be surveyed.

Indexed guidebook section tells industry what facilities and capabilities are available, where they are and how to utilize them. Information on the marketing of research and development availabilities will be reported

Newly revised government research and development contracting policies and procedures explained in detail.

GOVERNMENT

Missions, organizations and operating procedures of National Advisory Committee for Aeronautics; Air Research and Development Command; and Office of Naval Research summarized. Their laboratories, research stations and test center facilities, capabilities and availabilities analyzed in detail.

UNIVERSITIES AND SCIENTIFIC FOUNDATIONS

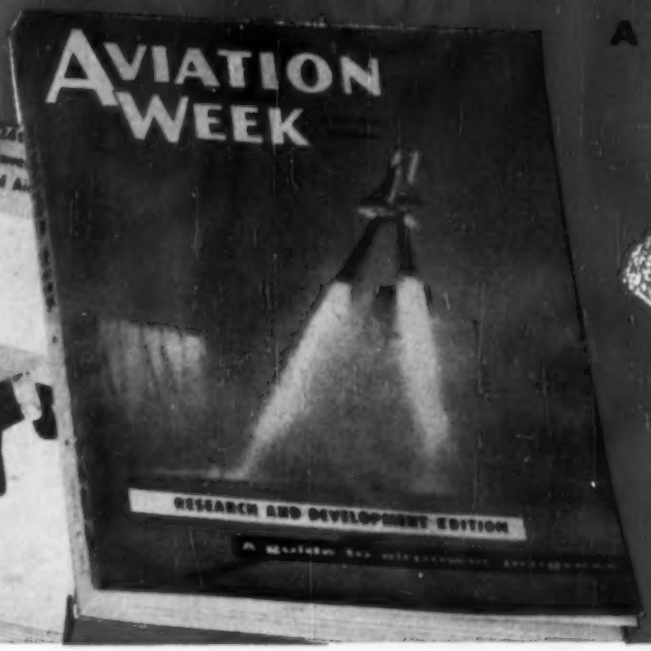
Exhaustive report on the important research and development programs at work at various universities and independent establishments throughout the country. Particular attention is given to the procedures of sub-contracting these resources.

INTERNATIONAL

Exclusive coverage of oversea's sources of research and development available to industry as reported by our Geneva, Switzerland office.

RESEARCH AND DEVELOPMENT EDITION JUNE 3rd

A Guide to Airpower Progress



Pioneer Research and Development Coverage

AVIATION WEEK pioneered research and development coverage in 1953 when it presented an exclusive full-scale report on the USAF Air Research and Development Command and the gigantic industry, military and scientific production team that it coordinates. Thousands of extra copies were purchased by government, industry, university and foreign establishments and used as the standard reference for training research and development and procurement personnel.

In 1956, AVIATION WEEK was called upon to publish a second Air Research and Development Command Edition to report the many changes, improvements and advances that had been made. It is now in use as a current standard reference and training aid on research and development.

AVIATION WEEK's 26 full-time graduate engineers and aviation specialists located in key aviation centers throughout the world will provide the editorial manpower and know-how for this newest research and development service edition. Their extensive experience in this field which was pioneered editorially by AVIATION WEEK assures an information packed Guide of outstanding usefulness and serviceability.

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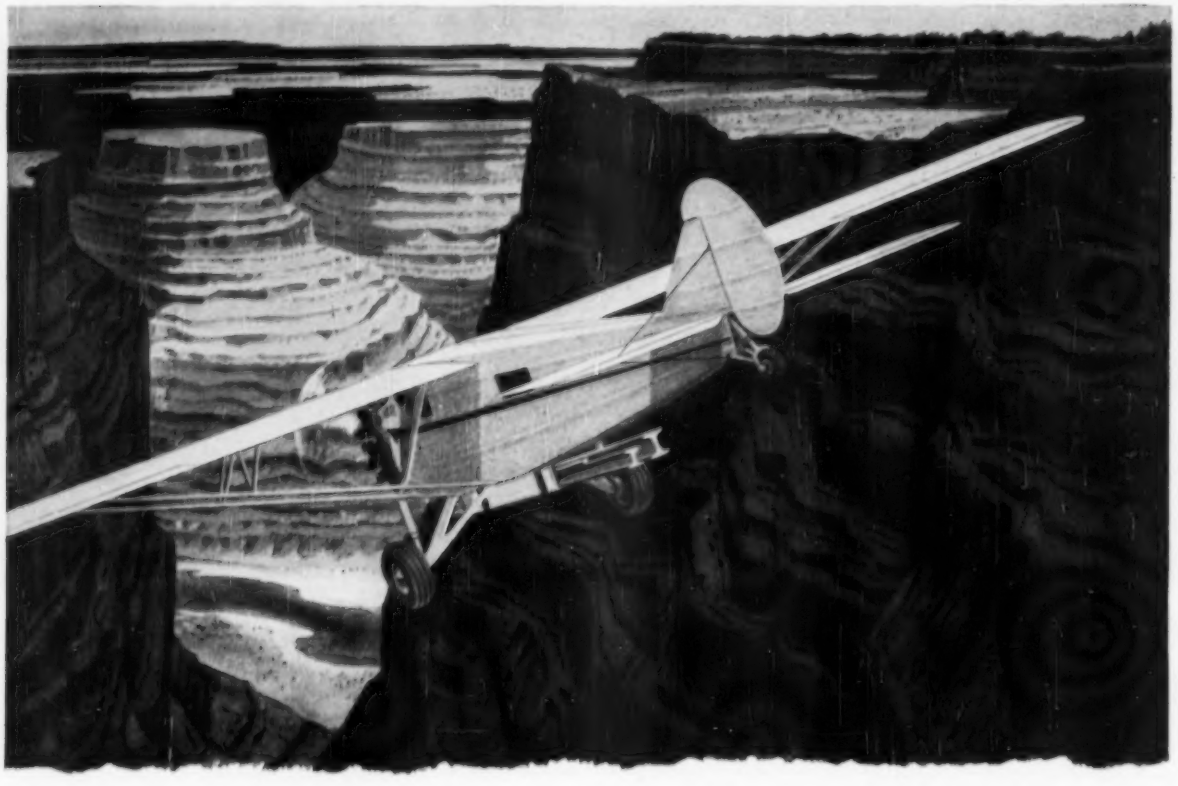
PLANE FAX

by STANDARD OIL COMPANY OF CALIFORNIA



4000 feet straight down—with a ton of steel

Not a disaster — just one of almost 200 regular flights made by E. M. "Buzz" Westcott to the bottom of the Grand Canyon. Taking off from Kingman, Arizona, where he operates the Kingman Flying Service, he's ferried steel girders, motors, cables, supplies and construction crews to a tiny sand strip 4000 feet below the canyon rim.

"They're building a tramline to haul guano to the top of the rim, and I've had to fly in everything they need," says Mr. Westcott. "My old Travelaire is just the ticket for this kind of heavy hauling — as long as I have Chevron Aviation Gas in the tank. Even on broiling hot days its P&W 450 puts out full power on Chevron with never a miss. Chevron never fouls plugs, either — I know it'll get me where I'm going, and get me back.

"Of course, I take care of my engines. I overhaul at 1000 hours for safety's sake, but I always find RPM Aviation Oil has kept the engines near-perfect right up to the teardown. 'RPM' holds engine compression at factory standards, keeps parts clean and free — I never have trouble with sticking rings or pre-ignition."

TIP OF THE MONTH

Bright-colored jackets and shirts sometimes cause reflections in the windshield, can cut night visibility. It's smart to wear dark clothes on night flights.

We take better care of your plane

CHEVRON AVIATION GASOLINE

AVIATION OILS RPM

T.M.'S "RPM," "CHEVRON," "PLANE FAX," REG. U. S. PAT. OFF.

D-SEAT with skip-flow generator uses rings on head rest. Stabilizing fins are extended. Skip flow generator protects pilot from supersonic air blast.

able to shift for himself after landing.

"Later on, we hope to develop the state of the art to the point where a crew member will feel like playing 18 holes of golf on landing—but that is still in the future," commented a Wright Field spokesman.

• **Open escape systems** are the immediate concern of ICESC. It is not worrying about capsules—at least not yet.

• **High reliability** is the factor dominating all efforts of ICESC to develop supersonic seats. As a spokesman said, "we will not compromise with reliability as complexity of the seats inevitably increases with their supersonic capability . . . we will only accept escape systems with the highest order of reliability." While the British Martin-Baker seat is very good, its standard of reliability was not acceptable to the USAF, he added.

Personal Equipment

Paralleling the supersonic ejection seat program is an investigation of air crew personal equipment to determine whether it will stand up under high speed ejection. Also under way is research into completely new personal equipment in case existing gear should prove unsatisfactory, as in the case of the MA-2 helmet. Goal of all these projects is to get suitable equipment into being in the shortest possible time —a true crash program.

Lockheed was well along with D-seat development when ICESC was established. "The D-seat was conceived and developed by us with detail design contributions from Stanley Aviation," Lockheed said.

Convair, while generally associated with the development of the B-seat, has credited that accomplishment to ICESC.

Stanley will translate the designs of both seats into operating hardware.

The D-seat can provide safe escape at speeds exceeding 800 kn. at sea level and Mach 3 above 38,000 ft., according to both Lockheed and ARDC. Its altitude capability reaches at least 60,000 ft.—possibly as high as 75,000 ft. The "D" designation of the seat indicates that it is the fourth design.

The B-seat, while not as far along in evolution and testing as the D-seat, will have approximately the same speed and altitude limits as the D-seat—far ahead of the 600 kn./50,000 ft. of current escape systems.

Recent Break Through

Magnitude of the speed and altitude breakthrough that new seats represent can be judged by the fact that, in the five years standard ejection seats have been in use, safe escape speeds have increased less than 100 kn. In the past seven months, addition of over 200 kn. plus a large altitude increase have been achieved.

Although the new seats will enable pilots to abandon their aircraft safely at speeds well into the supersonic, they are only an interim solution.

Eventual answer to supersonic survival must be the capsule, according to Stanley engineers. Air Force's recent edict has made capsules mandatory in future aircraft designs. Only way a man can survive abandonment of aircraft at speeds of Mach 5 and altitudes of 100,000-200,000 ft. is to be encapsulated. North American's X-15 is designed for such speeds.

With this eventuality in their sights, Stanley technicians are working on a small quantity of test sled capsules. Units already are in production and are scheduled for test in about six months.

Stanley is not restricting its life-sav-

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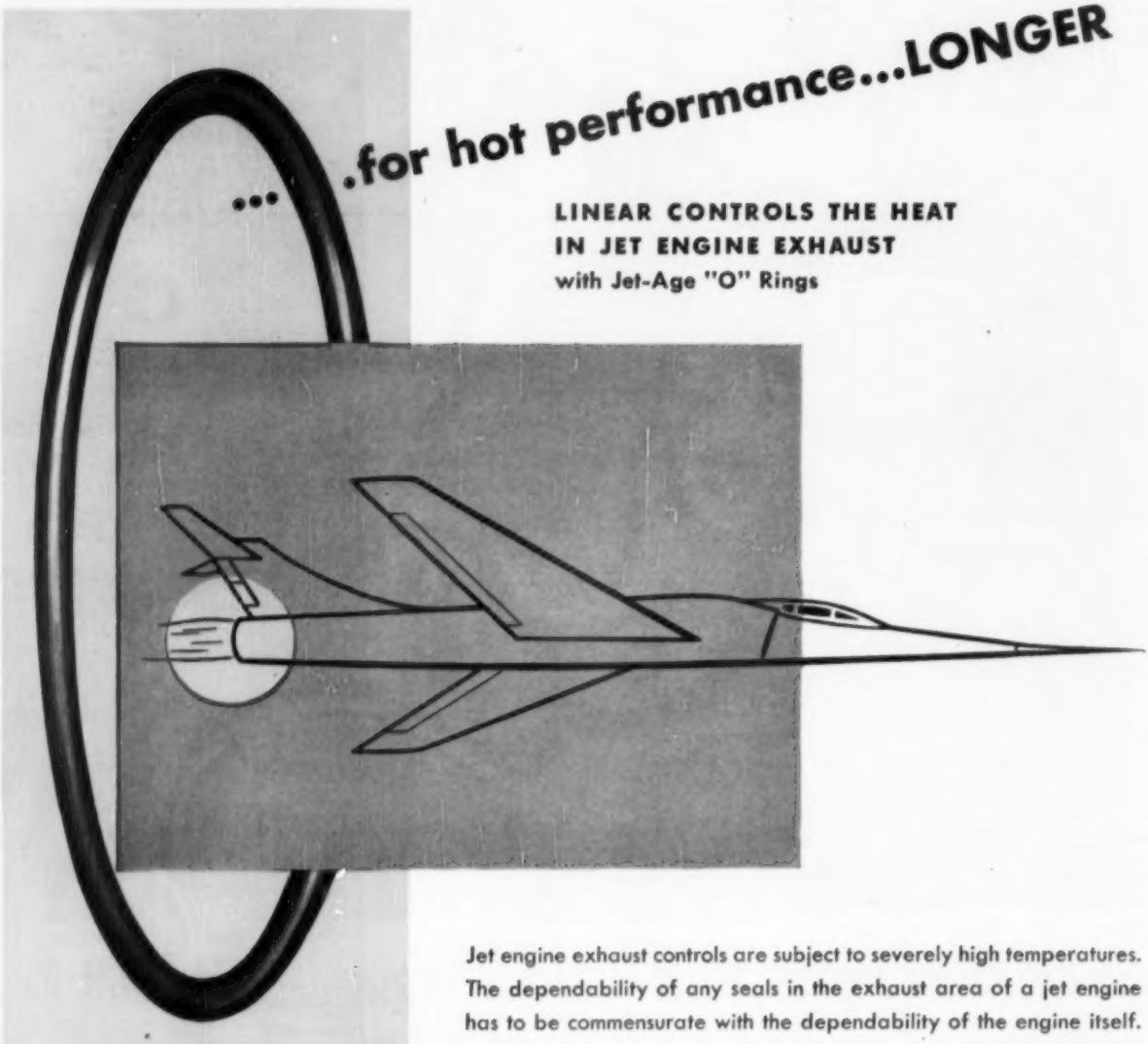
with Jet-Age "O" Rings



Jet engine exhaust controls are subject to severely high temperatures. The dependability of any seals in the exhaust area of a jet engine has to be commensurate with the dependability of the engine itself.

LINEAR'S ability and extensive experience in the design and manufacture of precision "O" rings—in such modern, heat-resistant elastomers as the silicone family—makes this kind of dependability a reality. LINEAR "O" rings, capable of withstanding intermittent ambient temperatures as high as 1000° F—and the destructive actions of gases and fluids, help control the jet engine exhaust—for hot performance—longer.

For a sealing problem of any kind—call on LINEAR or one of its agents for engineering assistance...

and be sure to Specify LINEAR "O" Rings for every application.

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LINEAR, Inc., STATE ROAD & LEVICK ST., PHILA. 35, PA.

ing efforts to combat crews. Richard H. Frost, Stanley vice president, told AVIATION WEEK that he is working on a system, called Impending Crash Alarm, for test pilots. ICA would automatically eject test pilots whose planes had plunged beyond controllable limits.

Industry Attitude

Attitude of the airplane manufacturers generally has been that the weight penalty imposed by supersonic escape systems could not be justified by the small percentage of ejections which would have to be made at supersonic speeds.

A single bail-out made by North American test pilot George Smith from a disabled F-100 Super Sabre at 777 mph. (AW Nov. 14, 1955, p. 14), whose life was saved by a succession of miracles, did more to galvanize the airframe industry into action than any other single event.

Plane makers had their attention inescapably drawn to the fact that supersonic escape was a real problem, upon them today and not tomorrow, and that a lot of lives of both test and service pilots were going to be sacrificed unnecessarily unless something was done about developing a true supersonic ejection system for their fast-flying planes.

C. L. (Kelly) Johnson, now Lockheed's vice president, engineering and research, then chief engineer, led a company team effort in the design and development of the radical, stub-wing F-104, for which the D-seat was designed. Major role in D-seat development is credited to Irving Culver, a veteran LAC engineer. He headed a group which produced the final seat configuration including its skip flow generator and stabilizer fins.

Crossbow and Net

For tools to develop this new, 20th Century life saver, Culver shunned such modern apparatus as supersonic wind tunnels—they required too much time. Instead, he reached into the past for an oversized cross bow and a butterfly net. He used the cross bow to launch ⅛ scale models of many different configurations of the seat. The butterfly net was used to catch the models at the end of their 200 ft. trajectory. Scale speeds of up to 1,000 kt. were simulated. The wooden free flight test models were ballasted to give dynamically similar performance to full-scale seats.

Use of the medieval machine in place of a modern wind tunnel sliced vital months of research and development from the time needed to come up with the final seat configuration. Wind tunnel data and mathematical analysis were then used to adjust scale flights to simulate full scale flight accurately over the Mach number range. Results were also correlated with available rocket sled data. Two major advantages of the Lockheed D-seat:

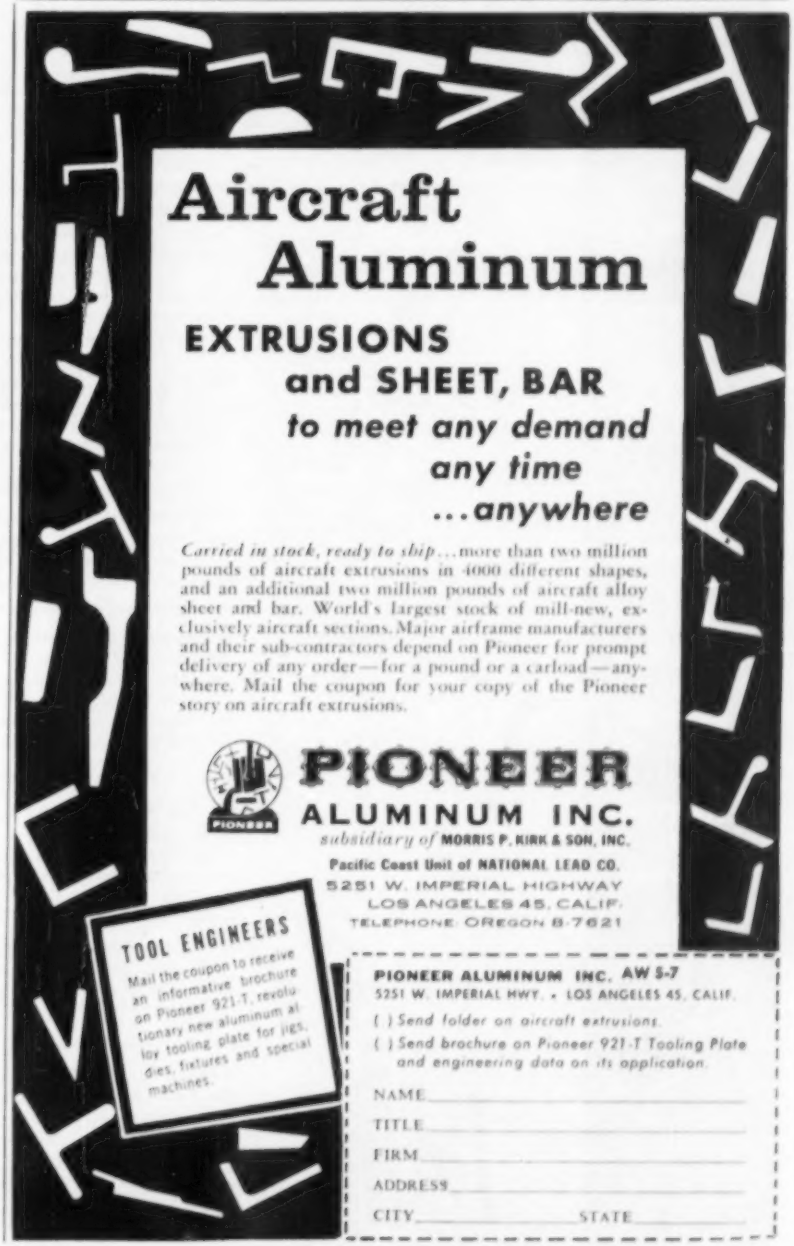
• **Lowest drag** of any ejection seat now known. It slows from 800 to 300 kt. in two seconds, imposing an initial deceleration force of 35Gs on the pilot—well within the limits of human tolerance.

• **High flight** stability over a wide range of speeds "to keep the pilot's body from becoming a virtual cocktail shaker for his viscera," as a Stanley spokesman put it. Also, stability prevents fatal hydrostatic heat being built up in the pilot's blood stream as a result of rapid tumbling.

Low drag feature of the seat results from the skip flow generator. This is a concave piece of lead protruding in front of the pilot on a boom. Lead is used to get as much weight as possible in a small space out in front of the pilot for correct center of gravity. Shape is trapezoidal, tapering from five in. at the bottom to two in. at the top; height is eight in.

The generator modifies the air flow pattern to cause flow separation around the pilot and his equipment. Three effects of the device are:

• **Reduces seat drag** by producing the effect of a faired body. Decelerative forces on the pilot are lowered by one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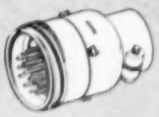

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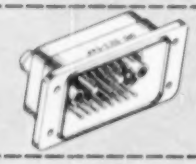

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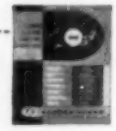

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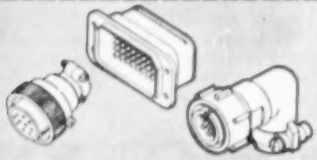

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third, making them tolerable to him.

- **Cuts air loads** on the pilot's chest by 75%.
- **Reduces wind blast** effect on the pilot's personal equipment. Frost thinks that retention of personal equipment is possibly the biggest single limiting factor in high speed escape from an aircraft.

Problem is to prevent the air blast from tearing the helmet from the pilot's head and to keep his flying suit from being ripped to shreds. The skip flow generator helps greatly in avoiding this problem.

A bonus inherent in the device is its characteristic of producing greater drag reduction with increased Mach number.

Stability of the seat is achieved by ballasting the skip flow generator correctly and by adding fixed vertical and extendable horizontal fins to the sides of the seat.

Pull the D-Ring

To escape with the D-seat, the pilot pulls a D-ring between his knees. After he has pulled the D-ring, this sequence of events then takes place.

- **Cartridge actuated devices,** or thrusters, raise knee supports to prevent leg spreading and counteract the effects of outward airloads. This motion simultaneously retracts pilot's feet with cables attached to a ball-and-socket arrangement fixed to his boot heels. This provides positive foot retention until time for man-seat separation (normal foot attachment and release is accomplished by simple foot action). Same motion also deploys two nets on seat sides to restrain the pilot's arms while allowing air loads to counteract inertia forces. Stanley engineers think the nets will be replaced by rigid supports to prevent net flapping.
- **Helmet is clamped** from sides to relieve effect of air loads on pilot's neck and to preserve favorable aerodynamics in this region.
- **Bottom seat** hatch is jettisoned.
- **Catapult ejects seat** downward a split second later.
- **Skip flow generator** is positioned by a thruster as bottom of the seat clears the fuselage so that it is in place and ready to protect the pilot before any other parts than his feet are exposed to the air blast.
- **Horizontal roll fins** are deployed by inertia and air forces.
- **Seat separates** from plane.
- **Delayed initiators** release the pilot's seat belt a short time later and cut the foot retraction cables to free him from the seat. This is done twice for safety.
- **Parachute opens automatically** when pilot reaches a predetermined speed and altitude.

If pilot ejects at a low altitude, the

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Valve Talk

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BY MARVIN MILES

Outside of San Diego a giant ballistic missile stands in a test rig, the Atlas, first intercontinental weapon of its kind, a hypersonic vehicle that may well revolutionize concepts of warfare.

The Atlas—along with the B-58 Hustler, first supersonic bomber—is the latest in a long series of achievements by Convair, now a division of General Dynamics Corp.

Yet only 34 years ago this massive company counted its first annual profit as exactly $201.98!

Founded by Maj. Reuben H. Fleet, Consolidated Aircraft Corp. first produced the TW-3 Trainer, a Dayton Wright design, then built an improved trainer prototype, the PT-1.

The success of the military trainer and its commercial versions (purchased by 22 foreign nations) has continued ever since, through an observation line added in 1928, through a Navy dive bomber, the Fleetster cabin monoplane, the PY-1 flying boat, the 32-passenger water-based Commodore transport that evolved later into the renowned P2Y and PBY Catalinas . . . through the rugged, hard-hitting B-24 Liberator, the C-87 Liberator Express and its Navy counterpart the PB4Y Privateer.

During the period of World War II, the company turned out more than 28,000 completed aircraft, nearly 13 per cent of the total delivered by the nation's aircraft industry.

From East Greenwich, the firm moved in 1924 into a World War I Curtiss plant at Buffalo, N.Y. Then, in 1935, the need for year-around flying weather and ice-free seaplane testing waters brought a move from Buffalo to San Diego and a single 300 x 900-foot building.

In March, 1943, Vultee Aircraft Inc., organized initially by a young pilot-engineer, Gerard (Jerry) Vultee, was merged into Consolidated to form the combined Consolidated Vultee Aircraft Corp., or Convair, with a controlling interest held by Avco Manufacturing Corp., the parent company of Vultee.

Subsequent joint stockholder actions (1) transferred control to the Atlas Corp. in November, 1947, and (2) merged Convair into General Dynamics Corp. in March, 1954, a year after the latter firm acquired 400,000 shares of Atlas holdings in Convair which is now a formal division of General Dynamics.

Throughout the expansions and the mergers, however, Convair matched stride for stride with other world leaders in aviation development, expanding to 13 divisions in World War II, including a trans-Pacific contract airline, Consairway, with a total employment exceeding 101,000.

It produced the nation's first turboprop aircraft, the USAF XP-81, was probably the first company to embark actively into the guided missile field, produced the world's largest bomber, the intercontinental B-36; turned out the world's largest land-based aircraft, the XC-99; produced the world's first turboprop seaplane, the Navy XP5Y-1, the famed, twin-engine Convair-Liner commercial transport, the first turboprop commercial transport, the Convair Turboliner, and the first twin-engine turboprop military transport, the YC-131 C.

In addition, the company came up with the world's first supersonic all-weather jet interceptor, the delta-wing F-102; the first high-speed jet seaplane fighter, the Navy delta XF2Y-1, and the first successful vertical take-off (VTO) fighter, the turboprop Navy XFY-1 Pogo.

Today the F-102s and TF-102s are rolling off the lines and the newer F-106As are coming up. Metropolitan 440 commercial transports are succeeding the Convair Liner 240 and 340 series. Development is underway on the Convair 880 commercial jet transport. A fleet of R3Y turboprop seaplane transports has been completed for the Navy.

The supersonic Texas-built Hustler is flying. Secret work is being rushed in the astounding Atlas missile and other classified missile projects. One program involves extensive research and development work leading toward the application of nuclear energy for the world's first atomic-powered aircraft.

Convair also operates for the Navy the nation's first and largest integrated plant for the production of guided missiles (Terriers) at Pomona, Calif., and has recently added an Astronautics Operating Division for research, development, manufacture and preliminary test of the Atlas ballistic missile.

How fast

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parachute is opened as soon as the seat clears the aircraft.

Special design features in the seat include:

• **Back frame of seat** eliminates any tendency of the seat to "tip-off" as it shoots out of the plane. Tip-off is tendency of the seat to rotate, feet back, head down. It is caused by the air blast hitting the bottom of the seat first as it emerges.

• **Roll fin extension** posed knotty problems. The fins must operate at any speed. Operation has to be positive, otherwise seat will roll and negate benefits of the skip flow generator. Stanley engineers designed the fin mechanism so the fins are allowed to go over center and are then repositioned with springs. To stop the extension process, which is violent at high speeds, energy is absorbed by extruding an aluminum billet over a mandrel. The overtravel arrangement assures that the fins will deploy correctly at low speeds while providing a method of absorbing the very high energy loads imposed by high speed ejections.

Downward Ejection

There are many advantages to a downward ejecting seat. There is also one big disadvantage—pilot cannot eject from zero altitude. Current minimum altitude is 300 ft.

Low altitude is no problem if speed is high and the pilot has control of his plane, since he can either roll it over and eject upward or zoom it to the safe ejection altitude of 300 ft. or more. But, if speed and altitude are both low, he is trapped.

R. Allen Price, Stanley Aviation's vice president, sales and service, cited these advantages of ejecting downward:

• **Lower ejection velocity** because there is no vertical tail to clear. Also, gravity and negative lift of the seat help, so that about 10Gs is the maximum imposed on a crew member ejecting downward. Upward ejection requires about 18Gs or more—close to the 20G limit for human endurance of positive vertical G loads; above this limit spinal fractures begin to occur. A related upward ejection problem is the relatively short distance—just a few feet—that the seat has to travel to attain maximum velocity. This may impose acceleration Gs on the pilot exceeding the 200G/sec. a human can tolerate in the positive vertical category.

• **Lighter structure** for the entire escape system is possible because of the lower G requirements.

• **Less space** is needed by the lighter, smaller structure.

• **Simpler, lighter and smaller** canopy is possible since it can now be hinged on the side. Reduction in size leads to improved aircraft performance.

• **Easier cockpit maintenance** is pos-

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LEAR

Test Stand for Titan

Test stand under construction by Martin Co. in foothills near Denver, Colo., will be used for static testing of Titan ICBM. Martin is building missile for USAF.

sible. Seat can be dropped out of the way and mechanics can stand in the cockpit to work.

F-104 Too Fast

Lockheed went to a downward ejection seat for its F-104 because the plane is so fast that a pilot could not tolerate the ejection blast that would be required to shoot him over the plane's vertical tail if he abandoned at maximum speeds.

However, the F-104 was designed before the recent development of rocket-tube seats.

This development may signal a swing back to all-upward ejecting seats to take advantage of their zero altitude potential.

An Air Research and Development Command spokesman told AVIATION WEEK that the Air Force is seriously considering converting the F-104 to an upward system.

The B-seat differs considerably from any known seat configuration. Basic concept is to rotate the seat 90 deg. during initial ejection cycle so that, as seat emerges from the cockpit, the pilot assumes a feet-forward-head-aft position. In this manner, his head will be exposed to the airblast only during the instant he moves out of the protection afforded by the windshield—which is acting as a skip flow generator—and before the seat is fully rotated, when the bottom will protect him. Stanley does not think the momentary exposure will be serious; ARDC engineers are not so sure. During separation, horizontal and vertical fins deploy along sides of seat to give it stability.

Pilot-plane separation does not occur until seat is completely rotated.

A downward and rearward firing rocket may be incorporated to give the same increased separation and reduced deceleration characteristics as the Talco seat.

Scale models of both B- and A-seats have been extensively wind tunnel tested. Both seat configurations are still subject to refinement and change as wind blast and ejection tests progress.

ICESC has recommended that both seat configurations be developed through the sled phase. Only after both seats have been so tested and evaluated will the ICESC attempt to determine which seat will be recommended for standardized application to all Century Series fighters. Possibly one configuration may be better suited to some planes, and the other to the remainder of the Century Series.

Final evaluation and review of the Air Force supersonic escape system development program is scheduled for this Fall.

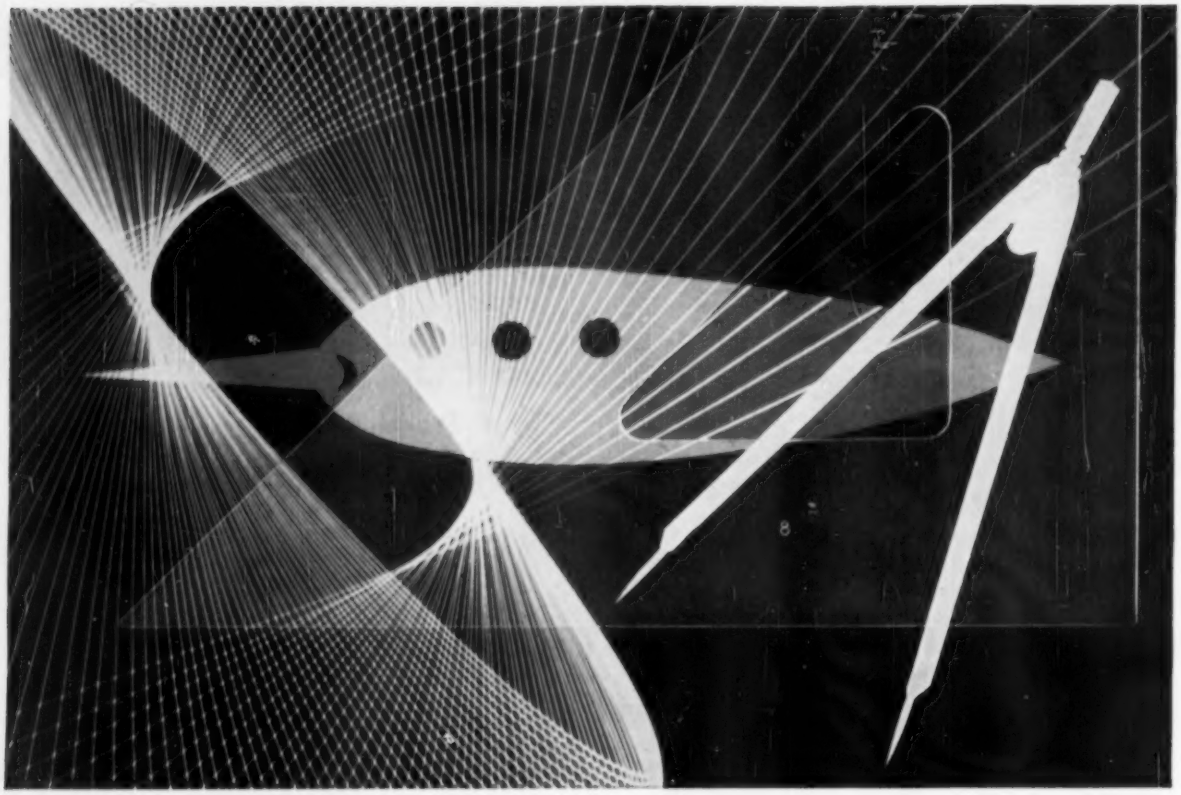
Escape Capsule

Frost summarized his thinking on supersonic escape and survival this way: "The engineering problems involved in escape from high performance aircraft are formidable, but a number of solutions are in sight. Application of weapon system thinking—the consideration of all the factors involved in successful escape—should result in a better safety record despite the continued increase in airplane performance.

Heavy emphasis is needed on two fundamental problems: making the decision to escape, and training personnel in use and maintenance of the escape system."

Need for a safe escape system for very high performance is underlined by the unlikely prospect of perfect reliability of all the accoutrements of supersonic flight—100% power boosted controls, electronic yaw dampers, automatic engine controls and related complex devices without which high Mach number flight is impossible.

Since D-seats and similar devices reach



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Assistant Chief Engineer Norman F. Parker joined Autonetics in 1948 after receiving his DSc from the Carnegie Institute of Technology. Dr. Parker has been recognized nationally for his work in Inertial Navigation, and was chosen recently to present a paper on that subject at a NATO conference in Italy.

Jack Wittkopf was Associate Professor of Electrical Engineering at Oregon State for 6 years before he joined Autonetics in 1951. Now Group Leader in computers and electronics, Jack lives with his wife and four children in Autonetic's home town of Downey, California, where his spare time activities include photography and ham radio.

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AUTOMATIC CONTROLS MAN HAS NEVER BUILT BEFORE

their limitations in the speed and altitude regions of about Mach 3 and 75,000 ft., and combat aircraft will soon exceed both of these limits, a new escape system must be found. Capsules appear to be the answer.

Problems of designing a capsule which will have deceleration and stability characteristics within the tolerance envelope of a human being are similar to those faced in designing a suitable supersonic ejection seat. There are differences, however. Deceleration is not so much of a problem because of the capsule's relatively high mass and streamlined shape. Actually, Stanley's first capsule will deploy a small drogue parachute ½ second after separation from the plane to slow it down. The chute will also provide yaw and pitch stability.

Tumbling and spinning will be avoided by extending stabilizing fins.

A problem inherent in ultimate capsule design, which does not plague seats, is how to include roll stabilization to tell the capsule which way is up. This will probably require a sophisticated and complicated gyro plus power to operate the gyro and the controls to right the capsule.

Examples of when roll stabilization will be needed are:

- **Separation at high** speed and low altitude. The detached capsule's kinetic energy can be used to zoom it to a safe altitude for parachute deployment if the capsule knows which way is up.
- **Separation** when the plane is in an unconventional attitude. A stabilization system will be needed to right the capsule so that it will zoom into the sky instead of into the ground.

Capsule should include:

- **Positive lift** through its aerodynamic configuration. This will help it "fly" to dissipate kinetic energy and zoom to safe altitude if necessary.
- **Weak links** attaching it to the airframe to allow it to break loose and slide off the aircraft in case of a sudden stoppage crash.
- **Hull integrity** and ballasting to allow it to float right side up.
- **Survival equipment** to keep the occupant alive until rescued.

Frost, a former engineering test pilot for Bell Aircraft and a member of the Caterpillar Club, stressed this enormous advantage of a capsule over an ejection seat: the pilot can shed most of his flight gear and figuratively fly in his shirt sleeves. With a true capsule, he can strip down to a G-suit, helmet and oxygen mask. Frost said personal equipment for high altitude flight is becoming so complicated and restrictive that it is impairing the pilot's efficiency in piloting complicated, supersonic aircraft.

Frost doesn't believe the common

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complaint of excessive weight should apply to capsules. Although a capsule does weigh about 175 lb. more than an ejection seat, the capsule helps to reduce the weight of the airframe because heavy structure, needed to carry stresses around the big hole that is the cockpit, can be lightened. The reduction in airframe weight approximately cancels out the weight penalty of the capsule, according to Frost.

There is no problem in severing the various controls and connections linking the capsule to the plane. Small lines, wires, push-pull rods or cables can be cut with cartridge actuated knives while large lines, such as air conditioning ducts, can include a slip joint arrangement with CAD-actuated valves to close them off quickly before the capsule is separated.

RATO Separator

Capsules probably will include a RATO separator to provide lift for the capsule, especially at very low altitude.

Frost believes that an Impending Crash Alarm should be developed to save test pilots when their aircraft get into uncontrollable situations or when they lose consciousness for a potentially fatal length of time. The former test pilot feels that all too often, test pilots stay with their expensive charges well beyond the point where recovery by a human being is possible and thereby sacrifice themselves unnecessarily.

Frost believes ICA should be used on a selective basis. A pilot could turn the system on just before starting a dangerous maneuver or test. He might also select between having the system give him a visual or oral alarm when the danger point was reached, or he might set it to automatic ejection in case he became incapacitated.

Survival Computer

The system could use inputs available in already existing equipment—such as air speed, altitude, attitude, ground proximity, and G loading. All data would be fed into a computer which would continuously compare this data with the aircraft's structural and maneuvering limits.

When the limits were exceeded, or altitude became too low to recover, the pilot would be ejected.

Weather Bureau Orders New Radiosonde Tracker

Servo Corporation of America will develop an instrument for automatically tracking a radiosonde transmitter of 50 milliwatts for 100 mi. Instrument, to be built under $1,258,845 contract from Weather Bureau, will consist of parabolic antenna, receiver, control chassis, housing and servomechanisms for automatic tracking.

ON MARK model 450 14-passenger executive transport will be powered by two Allison 501D turboprop engines.

On Mark Takes First Turboprop Order

First order has been placed by a U.S. corporation for On Mark Engineering Co.'s new Model 450 twin-turboprop-powered 14-passenger executive transport, unveiled recently at Van Nuys, Calif. (AW Apr. 22, p. 141).

Maytag Aircraft Corp., Colorado Springs, Colo., will take delivery of the first production On Mark Model 450 early in 1959. Initial prototype is expected to start its flight test program next summer. Current production planning is to produce two Model 450s monthly. Additional corporation orders for the Model 450 are being negotiated.

On Mark envisions maintaining this production rate for 60 months, turning out 120 airplanes, Company President Robert O. Denny told AVIATION WEEK. He added that he foresees selling 100 airplanes without difficulty to corporations for executive use. On Mark will also make the airplane available to the military services off-the-shelf as a VIP transport and crew trainer to replace current obsolete piston-engine equipment.

Price: About $1 Million

Price schedules on the Model 450 have not yet been settled. According to Denny, prospective buyers can figure on paying approximately $1 million for the airplane, with interior and custom cockpit included, but not including electronic equipment. Price includes installation of this equipment.

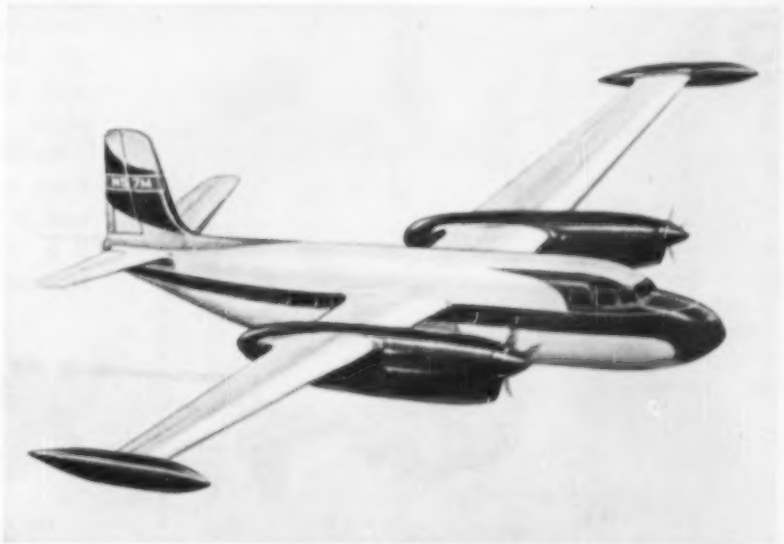
On Mark is working on a novel lease plan involving the Allison 501D powerplants, aimed at reducing the airplane's initial price. Since powerplant and propeller installation comprise a major cost item, it is trying to interest Allison in leasing these to Model 450 purchasers on a per hour basis. If this doesn't work out, On Mark probably will buy the powerplant package and handle the lease program itself.

Price Reduction

Advantage of such an approach would be to bring the initial price of the airplane down to approximately $800,000. Unofficial estimates on the cost of an Allison 501D installation is about $118,000 per nacelle, including propeller.

Denny told AVIATION WEEK that he has already placed an order for two Allison engines and Aeroproducts propellers. He added that the General Motors Divisions have been cooperating fully on the Model 450 project.

On Mark plans to build the Model 450 to meet Civil Aeronautics Administration Part 04B Transport-Category requirements. It is currently building a full-scale mockup, expected to be completed in about 60 days. It will also build a full-scale actual fuselage for structural tests in a water tank. Water tank test program will involve 10,000



MODEL 450, based on the Douglas B-26 design, will cost about $1 million. Aircraft will cruise at 420-430 mph., depending on load and altitude. Mockup is under way.

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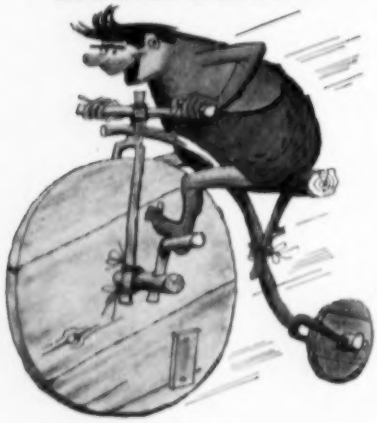

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Trainers: 15 Years' Difference

Last of 10,346 Boeing Kaydet trainers, standard World War II type, flies with Cessna's new T-37 jet trainer, now being phased into USAF operations. Dimensions of two aircraft are similar, but the T-37 is about 300 mph. faster.

theoretical flight hours on this portion of the airframe. Fail-safe construction practices will be followed to minimize damage in event of pressure blow-out at altitude.

New Airframe

Although the new Model 450 will utilize some remanufacturered Douglas B-26 Invader components, its design and fabrication will basically involve building a new airframe. B-26 components will include the wing, completely reworked so that actually only the main spars are retained; flaps, revised and enlarged tail, and landing gear.

Fuselage will be a completely new component, cylindrical in configuration with a 90 in. diameter.

On Mark has specialized in conversion of surplus Air Force B-26s for executive use since it was formed three years ago.

Dimensions of the new airplane will include: wing span (without wingtip fuel tanks) 72.3 ft.; overall length, approximately 64 ft.; overall height, about 21 ft.; wing area, 580 sq. ft.

Performance Data

Estimated performance data for the Model 450 with two 3,750 shp. Allison 501D-13/15 engines with full-feathering and reversible Aeroproducts propellers include cruise speed at 80% power of 422 mph. TAS at 30,000 ft. at 38,000 lb. gross weight. At this altitude the airplane will cruise at 429.5 mph. TAS at 34,000 lb.; 436 mph. TAS at 29,000 lb.

Takeoff gross weight will be 40,000 lb.; landing weight 33,000; lb.; empty weight 23,000 lb.

Rate of climb at 5,000 ft. (two engine) is estimated at 4,580 fpm. at 29,000 lb.; 3,750 fpm. at 34,000 lb.; 3,220 fpm. at 38,000 lb. At 20,000 ft., climb will be 2,620 fpm. at 29,000 lb.; 2,090 fpm. at 34,000 lb. and 1,735 fpm. at 38,000 lb.

One-engine rates of climb at 5,000 ft. will be: 1,530 fpm. at 29,000 lb.; 1,125 fpm. at 34,000 lb. and 880 fpm. at 38,000 lb.

Maximum two-engine ceiling will range from 43,500 ft. at 29,000 lb. to 34,700 ft. at 38,000 lb.

Takeoff Run

At 40,000 lb., the turboprop Model 450 will clear a 50 ft. obstacle after a ground roll of 2,070 ft., according to On Mark data. At 36,000 lb it will require 1,655 ft. ground roll and at 32,000 lb., 1,290 ft.

Landing distance over a 50 ft. obstacle at sea level at 33,000 lb., using anti-skid brakes and reverse props is calculated at 2,200 ft.

Maximum range will be approximately 3,100 mi. The Model 450 will have a fuel capacity of 2,100 gal.

Cabin pressurization will be handled by AiResearch equipment similar to that planned for installation in the Allison-powered Lockheed Electra turboprop transport. At 30,000 ft. recom-

THE AVRO ARROW

The name selected for the still secret AVRO CF-105 is symbolic of the pointed missile concept of this supersonic interceptor, being developed as the successor to the AVRO CF-100.

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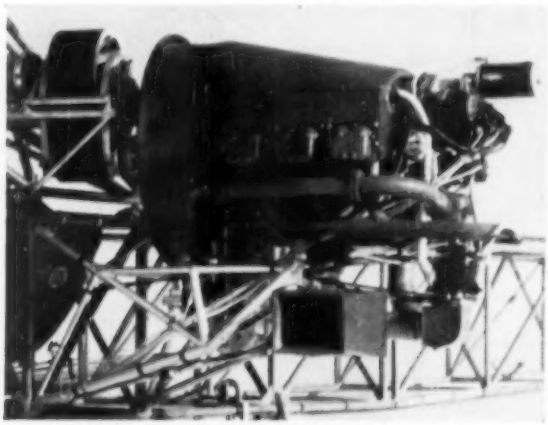

Detail of engine installation shows easy accessibility and unusual V-belt drive which greatly simplifies gearing and minimizes vibration.

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mended cruise altitude, cabin will be pressurized to 5,000 ft. mean sea level; when at 20,000 ft. the interior will be maintained at an equivalent of sea level. Dual cabin pressurization systems will be installed utilizing engine driven turbines. In event of an engine failure at 30,000 ft., the systems will maintain an equivalent of 12,000 ft. in the airplane.

On Mark is currently readying a full-scale sales and promotion campaign to build corporation interest, in its new project.

Now being prepared is a detailed brochure; plans also include building a 40-in. model that can be disassembled for traveling. Model would be capable of being dissembled to show the airplane's primary features, including passenger cabin layouts.

Model 450 origin dates back approximately 2½ years, when On Mark engineers started studies of a new pressurized fuselage design for its B-26 picton-engine conversions. About a year and a half ago, when it appeared that commercial turboprop engines would become available earlier than he had expected previously, Denny made some first-hand studies of the new powerplants including a visit to England to study the Napier Eland. Denny originally considered the Eland for the On Mark Model 450, switched to the Allision 501D eight months ago.

San Francisco Airport Raises Field Charges

San Francisco—Schedule of higher field charges designed to put San Francisco International Airport in the black by 1960 has been adopted by the city Public Utilities Commission. Airline executives have been asked to meet with the airport manager April 9 to negotiate on the proposed charges.

If the new schedule becomes effective July 1 as planned, some officials believe the airport will need no further tax support after this year.

The charges, which affect airlines according to their use of runways and other common facilities, would boost airport revenue from the present $459,000 to $881,000 annually. Income from landing fees would amount to 2½% of the $35 million invested in the airport by the city, and would be frozen at that rate for 10 years. As investment increases, there would be some variation in income during that period.

Income from common use now amounts to one sixth of the airport's revenue, but would jump to one fourth under the new schedule.

Three companies—Trans World Airlines, Western Air Lines, and United Air Lines—have contracts which include landing fees, but these are lower than those paid by other airlines. The city will try to reach agreement with these companies on removal of landing fees from the contracts, so all airlines will pay the same rates.

In other action, the PUC voted to employ Loubet & Glynn, San Francisco architects, to prepare plans for two new $800,000 to $1,000,000 concourse structures for the airport. These are part of the $25 million bond program approved by voters last November.

Newark Visibility Evaluation Changes

Newark, N. J.—Ceiling visibility evaluation program at Newark Airport on May 1, 1957, will change from giving out threshold contact height estimates to approach light contact height estimates.

U. S. Weather Bureau is conducting the program (AW Feb. 18, p. 107) under sponsorship of the Air Navigation Development Board and Air Force Cambridge Research Center.

The Weather Bureau said most pilots who have made approaches under reduced visibility conditions at Newark indicate preference for basing the evaluation on the slant visual range to the approach lights instead of the threshold lights. The approach lights at Newark

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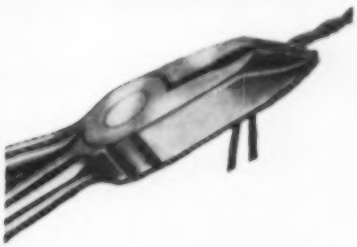

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Seen at McClellan Air Force Base, Eleanor is wiring an R-4360 engine — the type used on the B-36, B-50 and C-124 Globemasters. Her wire twister is a Robinson model M80 with the exclusive diagonal jaw design.

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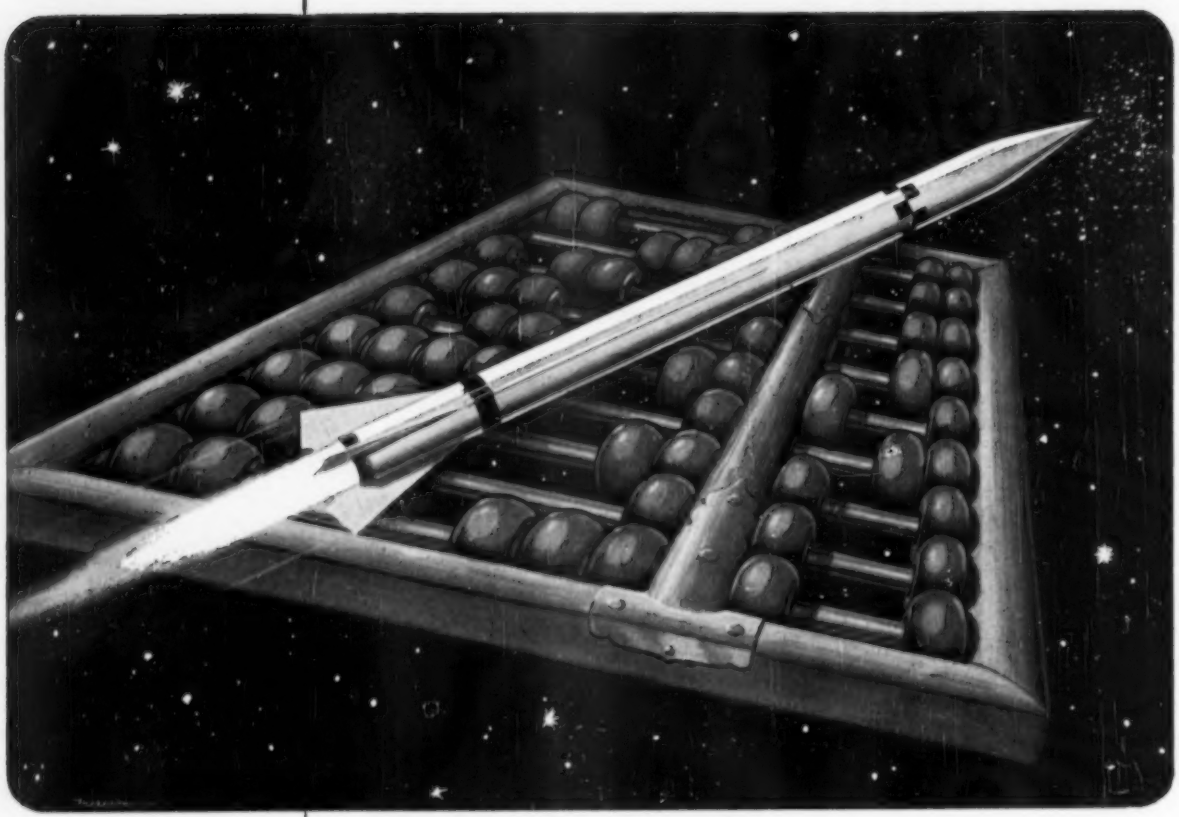

Computers for Missile Guidance

The Jet Propulsion Laboratory is a stable research and development center located north of Pasadena in the foothills of the San Gabriel mountains. Covering an 80 acre area and employing 1700 people, it is close to attractive residential areas.

The Laboratory is staffed by the California Institute of Technology and develops its many projects in basic research under contract with the U.S. Government.

Opportunities open to qualified engineers of U.S. citizenship. Inquiries now invited.

The abacus is a very ancient and useful computing device in the hands of a person versed in its use. However, the requirements for speed and accuracy in computing the functions necessary for modern missile guidance have obsoleted all man-operated devices, creating a need for computing systems previously considered impossible.

The Jet Propulsion Laboratory pioneered in the application of analog computing techniques to missile guidance systems and, to maintain its leadership in this field, constantly searches for new techniques that will make optimum use of magnetics, transistors and other modern computing components.

The successful application of these techniques to missile systems under development requires designs that will perform properly under the adverse environments found in today's guided missile. A degree of accuracy and extreme reliability, previously thought possible only under controlled laboratory conditions, is now a reality because of improved instrumentation techniques and development of highly accurate instrumentation equipment. This has been successfully applied to development of special purpose equipment for missile guidance.

The JPL guidance computer group, now engaged in research and development work encompassing electronic, mechanical, electromechanical and servo computing systems and their application to missile guidance and control, now offers attractive opportunities for truly creative engineers interested in advancing the state of computer art.

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Approach light contact estimates will be given out only by the CAA local controller on 118.3 mc. at the time each pilot reaches the outer marker inbound for a straight-in ILS approach to Runway 4.

The message will take the form: ". . . cleared to land, expect approach light contact between 300 and 400 feet —report approach lights in sight."

The Weather Bureau said the change will allow the program to determine the accuracy of method using ground based instruments to forecast the slant visual range of an approaching pilot. However, it said, the determination of whether approach light contact heights are of more value to the pilot than threshold contact heights can be made only by the pilots themselves.

With this in mind, all pilots are urged to visit the project building adjacent to the control tower at Newark Airport, or phone the project personnel at Mitchell 2-4414.

PRIVATE LINES

Narco Omnigator Mk. II navigation-communication equipment production is 15 units daily. Over 1,200 have been delivered since item was introduced last October. Production rate is highest company has achieved in its history on any other item for business aircraft. Omnigator Mk. II is now standard factory installed equipment on Beech Bonanza, Cessna 172, 180 and 182 and Piper Super Custom Apache.

Sales increase for second quarter of Cessna's 1957 fiscal year provided total sales of $17,233,000 compared to $15,004,000 for comparable period last year. Primary reason was increasing number of T-37A jet trainer and other military deliveries in period just concluded. Profits after taxes for the second quarter totaled $852,300 bringing earnings for the first half to $1,694,100. Cessna's military backlog is $91,750,000 compared to $41,700,000 a year ago. Total T-37A contracts add up to approximately $70,350,000.

A $300,000 contract for an electromagnetic and geophysical survey of 5,000 sq. mi. of northern Quebec has been awarded Spartan Air Service, Ltd., Ottawa, Canada, by 30 mining companies. Spartan will use modified World War II surplus DH Mosquito and Avro Anson twin-engine aircraft on the job, the former for aerial photo work and the latter for electromagnetic surveys.

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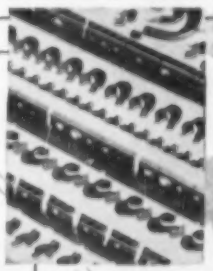

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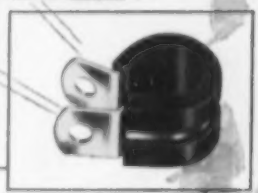

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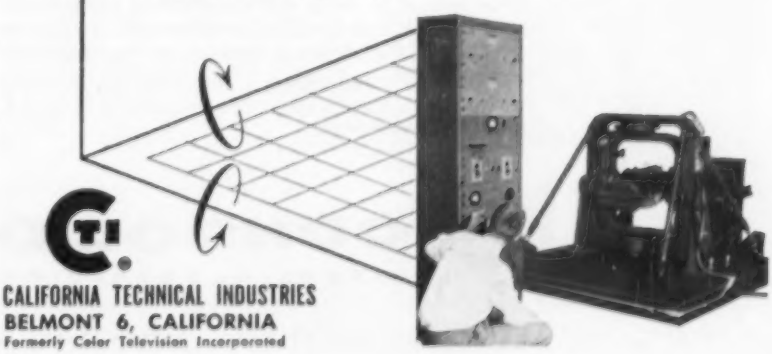

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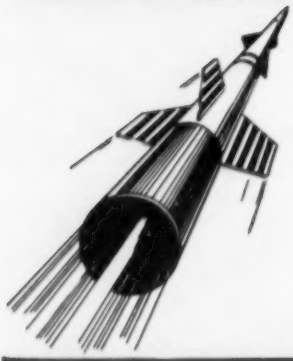

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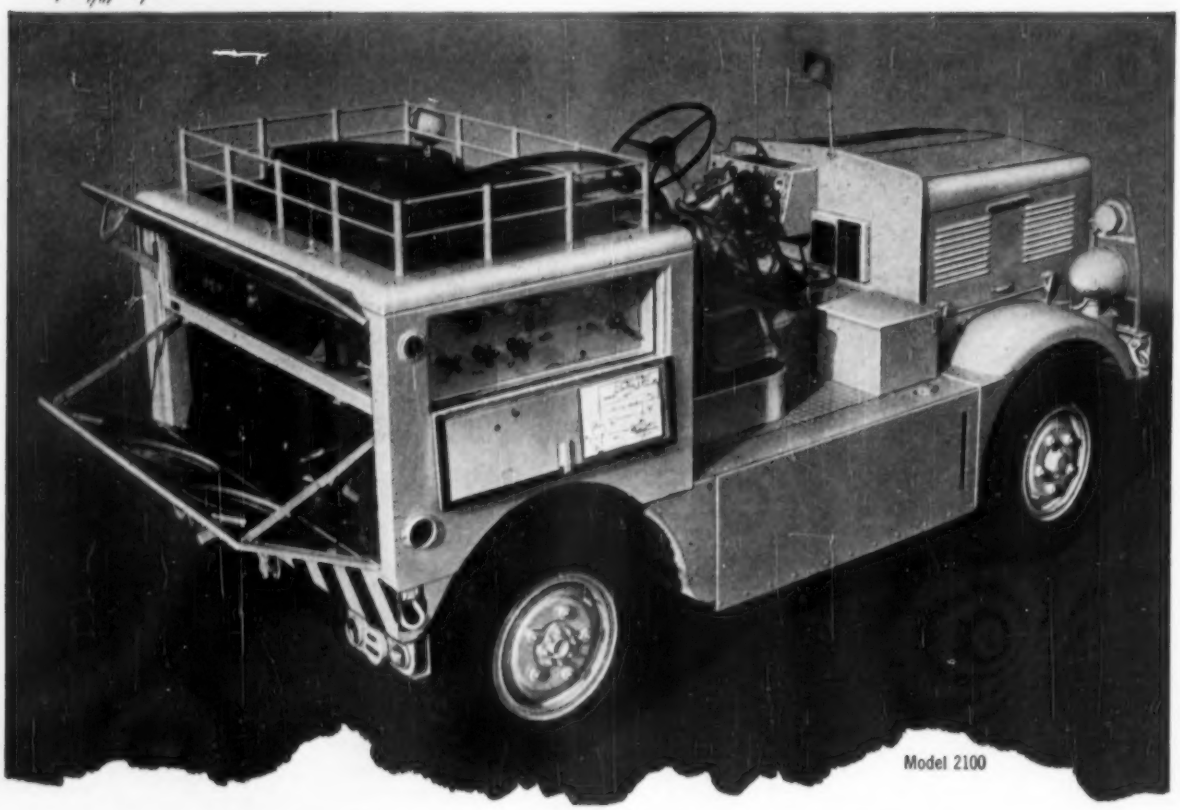

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Hearing Seeks Answer to Northeast Crash

By Glenn Garrison

New York—How a Northeast Airlines DC-6A which crashed on Rikers Island Feb. 1 went into an unexpected descending turn after takeoff from LaGuardia Airport and why the pilots were unaware of it were major questions posed at a Civil Aeronautics Board fact-finding inquiry here last month.

Among possible answers to the first question suggested by eight days of testimony from some 60 witnesses were these:

- **Frozen rudder trim tab,** breaking loose shortly after takeoff, might have put the plane into the unpremeditated turn.
- **Partial power-stall** by the heavily-loaded aircraft might have resulted in a turn and mush into the ground.

There seemed to be only two possible answers to the second question: the pilots were distracted from the instruments, or their instruments malfunctioned.

Pilot Testimony

Capt. Alva R. Marsh and Copilot B. S. Dixwell testified they were monitoring their instruments after the bad-weather takeoff, but Marsh said the first warning he had that anything was wrong during the 52-second flight was when Dixwell yelled, "Al, ground!" The plane crashed into the snow-covered island, skidded hundreds of feet and caught fire. Twenty persons died.

The inquiry was the third and biggest held under CAB's new rules allowing direct questions by interested parties. It ended in New York with expressions by all parties of satisfaction with the procedure. Hearing will be followed in about two months with the Board report on the accident.

Testimony during the hearing delved into Northeast's ground handling procedure problems at LaGuardia. Load of the Miami-bound flight was reported incorrectly to the pilot. One passenger's ticket was not collected. Maintenance records of the airplane had not been kept with complete accuracy.

Need for tightening up the ground operation was "obvious" from the evidence, A. A. Lane, Northeast's vice president-operations, told AVIATION WEEK. The procedures themselves are safe and satisfactory, Lane pointed out, but there had been need for more attention to them.

Only procedural change inaugurated since the crash, Lane said, was in the cockpit. Pilots now will wait until 500 ft. of altitude is reached before any attempt is made to change radio frequency.

This change has taken some of the load off flight crews at their busiest time, Lane said, a need underlined by the accident. But the move has no connection with any cause of the accident, Lane said.

Fact Finding

CAB member G. Joseph Minetti, who who sat on the six-man board of inquiry explained at the outset of the hearing that it was a purely fact-finding administrative procedure. The public inquiry followed a three-day pre-hearing conference held at New York International Airport.

Several main patterns of inquiry emerged:

- **Was the DC-6A overloaded** when it took off through the snow from Runway 4?
- **Was the plane,** owned by Main Elford Corp., leased by Flying Tiger Line and subleased by Northeast for its new Miami run, in proper mechanical condition at the time of the flight?
- **Did electrical failure** or some other malfunction affect the plane's instruments so the pilots received false information?
- **Were the pilots monitoring** the instruments carefully, and were they thoroughly experienced in using them under similar conditions?

Possibility of overload was examined from two points of view: uncounted passenger and baggage weight, and snow on wings and fuselage.

The plane had come into LaGuardia from Miami with the same crew and a light payload at 12:50 p.m. on the day of the crash. It was scheduled to go out again at 2:45 p.m., but snow removal and de-icing operations, both at the loading gate and in a nose hangar, delayed the takeoff time until 6 p.m.

According to the testimony of Northeast personnel, the load computation recap given to Capt. Marsh for the second flight showed a gross weight of 96,187 lb. including 82 adult passengers, six children, a crew of five and a check stewardess. The pilot received this information a few minutes before the scheduled departure time and it was the final word he had on his load before the flight began.

During the interval between scheduled and actual departure, the load changed. Correct figures at departure should have been gross weight 96,527 lb., 84 adult passengers, 5 children, crew of five and the check stewardess, and six infants—total, 101.

Gate agent failed to pick up one passenger's ticket and he was not counted in the final tally. Confusion was enhanced by substitution of four revenue passengers from a connecting flight for non-revenue passengers.

The load was, however, finally computed as less than the 97,275 lb. allowable gross that was then applied to the flight. The true maximum allowable gross, Lane testified, should have been 98,940 lb., considering the runway gradient and the 10 mph. wind value.

Considerable testimony was heard as to the efficacy of the snow/ice removal efforts at ramp and hangar. Ground crew gave up trying to clear the wings at the loading gate with brushing and Misco application, had the crew taxi the plane to the nose hangar.

The plane, with its passengers still aboard and about a third of its length including the tail still out in the snowy weather, remained in the nose hangar about an hour.

Reversed Props

Before it began to taxi out for takeoff, about 15 more minutes were lost in getting the aircraft clear of the nose hangar. Capt. Marsh twice reversed propellers in 8-10 second bursts trying to back the plane away from the nose hangar so it could be turned around. Two tugs finally succeeded, and the plane taxied out to the runway.

Total time from last removal efforts to takeoff: about 25 minutes.

Both the pilot's and copilot's testimony, however, clearly discounted the possibility of an overload or lift change from accumulation of the still-falling snow. Marsh, whose experience with snow in Northeast's New England operation has been extensive, said he checked the left wing during takeoff roll, and Copilot Dixwell said he checked the right wing. Both were completely satisfied that the wings were not affected by snow.

Northeast Airlines had flown 264 hours in the DC-6A, which it maintained in conjunction with Flying Tigers. Plane had logged 8,053 hr. in Flying Tigers service when North-

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east leased it in January, 1957. About 138 hours of the Northeast time was in scheduled service.

No evidence that anything was seriously wrong mechanically with the plane was introduced during the investigation. In fact, the pilots' reports that everything about the takeoff and brief flight seemed normal up to the impact would seem to preclude any trouble except with controls or instruments.

But the investigators' review of the aircraft's flight maintenance and historical record found "several areas of concern" regarding the way Northeast personnel were handling them. These included lack of proper filling or signing of flight logs, dating of work sheets, proper listing of replacement components, and failure of log sheets to conform to the master log, computed and retained by Flying Tigers.

Record Differences

Largest discrepancy found in the records involved the time since overhaul of the #1 engine. This was recorded in the master log as 1,378 hr.; the flight log of Jan. 3, Boston-Miami, listed #1 engine tso. as 1,123.2 hr. At the beginning of the next flight, Jan. 5, the #1 tso. was listed as 1,222.8 hr. The error was continued throughout the operation of the plane. About 98 hr. discrepancy in the log is involved here.

Testimony also disclosed that the crew had had trouble with the #1 propeller, which was overspeeding about 100 rpm. and required toggling in flight, but this was not regarded as serious.

Another point carefully examined in the hearing was how thoroughly the tail surfaces of the plane had been checked for icing prior to takeoff. John Joy, acting lead mechanic, testified that nothing was done to the rudder or rudder tabs during the deicing, but that he checked visually from a ladder. He could see the hinges and tab, he said, and they were free of snow. If there was ice, it wasn't showing, Joy said.

The CAB investigators studied instruments recovered from the wreckage and also performed a series of electrical tests at Chicago Midway Airport. The electrical tests indicated that under certain conditions, electrical power to some instruments might be interrupted without a light warning the pilot of the failure. But nothing in the reports indicated whether the instruments in the Northeast DC-6A had failed.

Sample electrical test performed in another Flying Tigers DC-6A, as reported by the investigating group:

"Fuse in Phase A of primary of the captain's instrument transformer was removed. The captain's inverter

warning light did not come on at once. However, it did come on 5 minutes later while the group waited for gyro horizon to tumble.

"Phase A fuse was replaced; after allowing gyros to reach operating speed, Phase C fuse of primary side of same transformer was pulled. Captain's inverter warning light came on at once.

"Fuse was replaced. Following a similar procedure, Phase A and Phase C fuses of secondary side of transformer were individually removed. In each case the warning light came on as soon as fuse was removed.

"All instruments were then operated from the upper inverter and its circuit breakers individually opened to observe the behavior of the inverter warning lights. When Phase A circuit breaker was opened, neither the captain's nor first officer's warning light came on. When Phase C circuit breaker was opened, the warning lights came on at once.

Another Test

"With the inverter selection again set so the captain's flight and engine instruments were on the upper, and the first officer's flight instruments on the lower, checks were made: Secondary voltage of the captain's instrument transformer was measured between Phases A and C and found to be 26 volts a.c. Allowing time for the gyros to reach operating speed, the Phase A circuit breaker of the upper inverter was opened. The secondary voltage rose from 26 to 29 volts and remained constant while being observed for 1.5 minutes."

Capt. J. D. Smith, speaking for Air Line Pilots Assn. at the hearing's conclusion, said the case will require an unusual amount of further analysis and study. Particularly important, Smith said, will be the exploration of the use of electricity in airplanes. No one really understands all aspects of this matter in modern airplanes, Smith said, and he added that even now, it was uncertain what the basic wiring diagrams had been in the plane.

As to how the airplane could be turning and dropping without some indication to the pilots, each said that it seemed reasonable to assume that something must have been wrong with the instruments.

Testimony of the two captains gives the following picture of events in the cockpit prior to and during the flight:

The pilots re-boarded the aircraft in the nose hangar after being advised it was ready to go. Curtain covered the front two thirds of the plane at this time and aft section of the aircraft, including its tail, was not easily visible. Brief visual inspection was made.

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Marsh turned on the wing and tail anti-icing heat. During this period, the heat was on for a total of about 15 minutes.

Run-up was normal, and the check list was run through. Marsh checked his controls by rolling the ailerons fully in both directions, moving the rudder both ways, moving the elevators both ways, moving the elevator tab. Rudder was moved to spring tension only, as far as Marsh recalls. The rudder tab was at neutral and Marsh didn't move it.

The omni receiver on Marsh's side of the cockpit was tuned to Caldwell VOR, with 81 degree radial set in the course line indicator. His ADF was tuned to Patterson. Co-pilot's ADF receiver was tuned to La Guardia range. Captain's C-2 compass read 43-44 deg. as the plane lined up with the runway.

At this point, snow was falling, ceiling was about 500 ft., visibility about ¾ mi., and there was some fog.

As Marsh started the takeoff roll, he checked his left wing for snow accumulation. Only a white film, he said, remained on the section of wing he could see. The props were blowing it clean in some areas, and he was confident there was no problem. Dixwell also looked at the right wing, checking the cowl flaps—which were closing normally—and saw the wing was clear of snow accumulation. The landing lights were on, to help visibility in the dusk and falling snow, and they remained on throughout the flight.

Nosewheel Steering

During his initial roll, Marsh found the nosewheel steering ineffective because the plane was sliding a little on the snow-covered runway. He therefore steered principally with his rudder after it became effective at about 50 kt. He made a few "reasonably large" movements of the rudder. Dixwell called off the V_1 and V_R speeds, and the airplane broke ground at about 111 kt., the V_R speed. It was pointed straight down the runway at the moment of takeoff.

Immediately after the flight was airborne, Marsh called for gear up and "went solidly on instruments." He may have used some elevator trim tab, but doesn't definitely recall. His altimeter started to move upwards; rate of climb was about 800 fpm. He later observed that rate of climb had fallen back to 400 fpm. His bank-turn indicator was centered; artificial horizon indicated straight and level; C-2 hunted slightly between 40 and 45 deg. At 125 kt. TAS, the captain called for zero flap (from 20 deg.). He continued his appraisal of the complete instrument panel "as much as possible." Only altimeter reading he noticed was while the plane was "going through 200 feet."

Marsh saw the air speed accelerating through 135 kt., glanced at the flap indicator and saw that it was still retracting. At 140 kt. IAS, he called for METO power and observed the flight engineer begin his power reduction. For awhile everything seemed "extremely normal." Suddenly Dixwell called "Al, ground," Marsh saw the ground, pulled up on the yoke, but there was no response. The plane hit in what seemed to be a normal landing attitude—"not a hard crash at all." It slid smoothly for some distance.

Copilot Account

Copilot Dixwell, after checking the right wing, spent the takeoff roll watching airspeed and calling off V_1 and V_R speeds to the captain, and also in monitoring the takeoff visually. He could see by the runway lights that the aircraft was rolling close to the center line of the strip. As soon as the plane was airborne, Dixwell concentrated on his instruments. He also made a radio contact, acknowledging the tower's instructions to change to departure control frequency. After passing through 125 kt, he raised the flaps on Marsh's command. Then Dixwell monitored the panel generally. Airspeed was increasing steadily; the altimeter and rate of climb were showing a rise in altitude, and the heading (from course line indicator) was between 40 and 45 deg., as it should have been.

Dixwell continued to monitor his instruments until Marsh asked for METO power. According to the copilot, this was at an airspeed of about 140 kt. and at an altitude of 300-350 ft. At the command, Dixwell "visually left the flight instrument group" and watched the engineer reduce power. "Quite a few seconds" went by while he was watching the engineer. At this time he was also reaching for his radio selector to change to departure control frequency. Something ahead suddenly attracted his eye; he looked through his side of the windshield and saw the ground. He hardly got the call to Marsh "out of my mouth" when the plane hit.

Neither pilot felt any physical indication when the aircraft was turning or that anything other than a normal climbout straight from Runway 4 was taking place. Asked by Minetti to explain the "apparent inconsistency" between an instrument indication that everything was normal and the actual circumstances, Dixwell said "I suppose you could come to the conclusion" that the instruments were not functioning properly.

Testimony of flight engineer Angelo Andon bore out the pilots' reports that the takeoff seemed normal in all respects.

Northeast's counsel asked Marsh if

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he might have partial amnesia about the events just before the impact. Chairman Robert W. Chrisp of the inquiry board ruled this question too speculative.

A Coast Guard helicopter pilot, Lt. Cmdr. Fletcher Brown, who tried to take his S-55 out to Rikers Island the night of the crash but was forced by poor visibility to stop at LaGuardia, testified he talked to Dixwell by phone while the copilot was still on the island. The witness said he asked Dixwell if he and Marsh had both been IFR or on a split watch, and Dixwell replied he didn't recall—that they had been "right in that moment of transition."

Dixwell said later from the witness stand that he meant transition "between takeoff configuration and climb configuration."

Rudder Tab Test

Check of the possible effect of an unexpected rudder trim tab action was made during two of five flights CAA made from LaGuardia in a DC-6B. Flights four and five were as follows:

Flight four: Altitude 6,000 ft., 20 deg. flaps, rudder trim 3 deg. left. Heading was held by right rudder for about 1 minute—then rudder released and flaps retracted. Plane made rapid left turn and descent.

Flight five: Altitude 6,000 ft., 20 deg. flaps, hands-off trim. Then trim of 3 deg. cranked in, no rudder applied. Plane made rapid left turn and descent.

In the first of the test flights, the DC-6B took off from Runway 4 and made a 45 deg. bank. Flaps set at 20 deg. were retracted. Airspeed in turn was 140 kt. IAS. The plane passed over the accident point of first impact on Rikers Island at 350 ft. altitude 35 seconds after takeoff.

Possibility of an in-flight explosion was raised by testimony of several witnesses but discounted by the experts. One of the witnesses, NEA stewardess Emily Gately, whose statement was read at the hearing because she had been readmitted to a hospital for injuries received in the crash, described the first part of the takeoff and climb as normal. Then the plane turned to the left, the stewardess reported, and there was a small explosion while they were still in the air. Other witnesses mentioned an explosion.

Some confusion arose from a New York police laboratory report which found that "the explosion in the left horizontal tail stabilizer occurred before the plane made contact with the pine trees" at some point during the plane's flight. This finding seemed to disagree with the CAB investigators' conclusion that a tail heater explosion occurred after impact, based in part on the fact that torn skin on the leading edge of the stabilizer would have blown off if it had been damaged in the air. A supplemental statement from the police laboratory, however, explained that "flight" in the report referred to the plane's movement from beginning until it came to rest.

Several passengers who had been aboard the flight told of anxiety during the long delay before takeoff and of requests that they be permitted to deplane. One passenger testified he was told that he might leave the aircraft, but that it would be impossible to take his baggage off. He remained.

Interested Parties

Among the interested parties at the hearing was Queens County assistant district attorney, Bernard M. Patten, who put a number of sharp questions to the Northeast personnel on the stand and was sometimes restrained by Chairman Chrisp. After Marsh's original testimony, Patten asked him, "What caused the accident?"

Marsh replied "I believe that's what we're here for," and Joseph O. Fluet, investigator in charge of CAB's bureau of safety and a member of the board of inquiry, told Patten "I believe it would be completely premature" for anyone to speculate before all the facts were in.

Near the end of the hearings, however, the board asked Marsh whether he could provide any idea of what happened to cause the accident.

"No, I wish I could," Marsh replied.

At the hearing's close, Minetti expressed CAB's view that the procedure had been of "tremendous help" in the investigation, and a "very substantial contribution" to the Board's fact-finding work.

USAF Contracts

Following is a list of unclassified contracts for $25,000 and over as released by Air Force Contracting Offices:

AIR FORCE CAMBRIDGE RESEARCH CENTER, ARDC, USAF, Hanscom Field, Bedford, Mass.

Fairchild Camera and Instrument Corp., Robbins Lane, Syosset, L. I., N. Y., modifying the design of the present CARTRAC with improved techniques AF19(604)-2070, job, $61,632.

Bolt, Beranek and Newman, Inc., 50 Moulton St., Cambridge, Mass., recording the auditory display of radar information, AF19(604)-2052, job, $44,810.

Radiation Engineering Laboratory, Main St., Maynard, Mass., research services to design, develop and fabricate triple diversity antenna system, AF19(604)-2224, job, $37,658.

Wentworth Institute, 550 Huntington Ave., Boston, Mass., research directed toward the determining of various schemes for the production of high power electromagnetic pulses, AF19(604)-2199, job, $49,999.

Texas A & M Research Foundation, College Station, Tex., studies of the synoptic application of weather radar data, AF19(604)-1564, job, $35,000.

Prototypes Engineering and Development Corp., 34 Tappan St., Manchester, Mass., design, development and fabrication of lightweight lowering device, AF19(604)-22.

High Altitude Observatory of the Univ. of Colorado, Boulder, Colo., study of solar terrestrial relations AF19(604)-2140, job, $38,000.

Woods Hole Oceanographic Institution, Woods Hole, Mass., reduction of gravity

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data and extending gravity pendulum measurements, job, $48,000.

The Board of Trustees of the Univ. of Ill., Urbana, Ill., gaseous electronics research, AF19(604)-2152, job, $85,000.

Motorola, Inc., 8330 Indiana Ave., Riverside, Calif., research to determine the feasibility of developing a slant visual rage meter, job, $53,508, (AF19(604)-22-13).

William M. Wolf Co., 200 Berkeley St., Boston, Mass., digital computer programming and terminal equipment logical design services, job, $47,546, (AF19(604)-2236).

Airborne Instruments Laboratory, Inc., 160 Old Country Rd., Mineola, N. Y., design, develop and produce a very high frequency triple deversity radio receiver, job, $36,754.

Allen B. DuMont Labs., Inc., 750 Bloomfield Ave., Clifton, N. J., design, development and fabricator of a VHF linear amplifier, job, (AF19(604)-2225), $29,083.

Young Development Lab., Inc., P. O. Box A, Rocky Hill, N. J., development of a fiberglass deployment tube, job, $32,689, AF19(604)-2211.

Paul M. McPherson Precision Instruments, 527 Main St., Acton, Mass., development of dispersion assys., job, $41,060, AF19(604)-2219.

Westinghouse Electric Corp., 2519 Wilkens Ave., Baltimore, Md., study of VHF/UHF transmitters as applied to tropospheric scatter communication links, job, $29,589, AF19(604)-2194.

R. G. LeTourneau, Inc., 4014 MacArthur St., Longview, Tex., design, test and furnish electric ground launch vehicle, job, $80,333, AF19(604)-2221.

AF MISSILE TEST CENTER, ARDC, USAF, Patrick AFB, Fla.

Consolidated Electrodynamics Corp., 300 North Sierra Madre Villa, Pasadena, Calif., recorder, 7CAC-NL624994-57, 3 ea., Valvanometer, 7CAC-NL113531-5225, 125 ea., galvamometer, 7CAC-NL313509-454, 55 ea., magazine, 7CAC-NL11107-25, 3 ea., (PR 57-1242-2), $38,352.

Migo Electronic Corp., 7601 N.W. 37th Ave., Miami, Fla., real time data transmission system, (PR 57-1157), job, $93,395.

Cardiox Corp., 307 N. Michigan Ave., Chicago 1, Ill., compressor, 8200-NL143626-475, 2 ea., (PR 19-A-57-LP-15820), $54,-568.

DAYTON AIR FORCE DEPOT, Gentile AF Station, Dayton 10, Ohio.

Eitel-McCullough, Inc., 798 San Mateo Ave., San Bruno, Calif., tube-electron pulse amplifier glass envelope MIL-6C21 a/w spec MIL-E-1C dtd 3 Oct 55, 1,000 ea., (IFB 33-604-57-214), $47,500.

Carrier Corp., Spectrol Electronics Div., 1704 S. Del Mar Ave., San Gabriel, Calif., resistor, variable, linear precision, mfg: spectrol model 100-114, 70 ea., resistor, variable linear precision mfr: spectrol model 100 std, 600 ea., resistor, variable linear precision mfr: spectrol 300-460 in a/w Dalmo Victor Dwg 372B27803 and ESO 56A-10683, 400 ea., (RFP 33-604-57-1612), $31,603.

Chatham Electronics, Div. of Gera Corp., 630 W. Mt. Pleasant Ave., Livingston, N. J., tube-electron receiving reliable miniature type MIL 5783 WD a/w spec MIL-E-1/788A (Navy) dt 10 Sep 54, 7,000 ea., (IFB 33-604-57-196), $40,250.

Aemco, Inc., 10 State St., Mankato, Minn., relay-armature pile-up type Aemco P/N83-1296, 1,200 ea., relay-armature Aemco P/N38-1265, 500 ea., relay, armature Aemco P/N 45L-1137, 13,000 ea., relay, armature Aemco P/N R41A1347, 400 ea., (RFP 33-604-57-1517), $51,620.

Struthers-Dunn, Inc., Lambs Rd., Pitman, N. J., relay-armature nonpile up type DPDT Struthers-Dunn P/N139BX101, 100 ea., relay-armature nonpile-up 3PST Struthers-Dunn AICXX, 100 ea., relay-armature nonpile-up type Struthers-Dunn P/N 8BXX, 100 ea., relay, armature, 2 PST Struthers-Dunn P/N 112AAX101, 260 ea., relay-armature nonpile-up type Struthers-Dunn P/N 91 BAX100, 280 ea., relay, solenoid, SPDT Struthers-Dunn type 112XXX306 200 ea., relay-armature nonpile-up type Struthers-Dunn P/N 2BXX109, 300 ea., relay, solenoid, SPDT Struthers-Dunn type 49 XXX-108, 20 each., contact set, relay, Struthers-Dunn P/Ns: No. 4892, No. 17905, 50 ea., relay, armature non-pile-up type DPST Struthers-Dunn P/N 8BXX155 dwg No. 11391, 50 ea., relay armature Struthers-Dunn P/N 182BXX102, 1,500 ea., (RFP 33-604-57-1543), $65,205.

Airite Products, Inc., 3516 E. Olympic Blvd., Los Angeles 23, Calif., switch, pressure SPDT Airite Prod P/N 6012A, 200 ea., switch, pressure SPST Lockheed Acft part/dwg. 613260, 94 ea., cover, electrical switch Airite Prod P/N 306, 150 ea., Gasket, asbestor Airite Prod P/N 126, 176 ea., packing, preformed rubber Airite Prod P/N 164, 785 ea., (RFP 33-604-57-1638 Q), $47,210.

Polarad Electronics Corp., 43-20-34th St., Long Island City 1, N. Y., analyzer, spectrum AC, AN/UPM-17 in a/w Mil spec MIL-S-4469A (USAF) dtd 18 Feb 55 and the contractor's engrg change proposal No. 1C dtd 19 Aug 55, 122 ea., maint data (revisions) engineering data (revisions), (IFB RFP 33-604-57-1432), job, $397,660.

Potter and Brumfield, Inc., Princeton, Ind., relay assy, contractor's P/N SH-12080, 1900 ea., relay assy, contractor's P/N SH-12932, 600 ea., (PR's 648599 and 685062), $41,927.

Struthers-Dunn, Inc., Lambs Rd., Pitman, N. J., relay, armature, Struthers Dunn P/N 7800-1101, 1140 ea., (IFB 33-604-57-266), $85,408.

Frebank Co., 6441 San Fernando Rd., Glendale, Calif., switch, pressure SPST Frebank P/N 4000-16, 1100 ea., switch-press SPST Frebanks P/N 4000-26, 200 ea., (IFB 33-604-57-266), $26,975.

Telectron Ind. Corp., 35-16 36th St., Long Island City 1, N. Y., modulator MD-83A/ARN, 196 ea., maintenance data, (Revisions), (IFB PR: 628261), $171,500.

General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass., tester, fuel quality gage variable capacitance in a/w spec MIL-T-8579, USAF MD-1, General Radio P/N P-579, QPL No. 8579-1 dtd 6 July 55, 12435 ea., photographs (with negatives), 3 sets, maintenance handbook data, engineering data, (IFB 33-079-57-109), $880,879.

Kings Elec. Co., Inc., 40 Marbledale Rd., Tuckahoe 7, N. Y., connector plug, UG-1185/U in a/w Navy dwg RE49035 except that page #3 of the ward entitled "Exception to Dimensions shown on Navy dwg REB 49035" shall be complied with, 8000 ea., (IFB 33-604-57-36), $47,440.

AMC Contracts

Wright-Patterson AFB, Ohio—Following is a list of unclassified contracts as released by the Air Materiel Command, Wright-Patterson AFB, Ohio.

Northrop Aircraft, Inc., Hawthorne, Calif., implementation of T-38 aircraft program, (PR 749951), $2,714,996.

Lockheed Aircraft Corp., Burbank, Calif., development and testing of a high speed escape system for aircraft with downward ejection, (PR PH-631619), $200,000.

North American Aviation, Inc., Los Angeles Int'l Airport, Los Angeles 45, Cal., installation of a Government furnished aeronautical equipment prototype modified E-10 Minneapolis-Honeywell type MH-44A autopilot and perform a flight test program on bailment F-100A airplane, (PH-177877), $585,889.

Bendix Aviation Corp., Eclipse-Pioneer Div., Teterboro, N. J., amplifier, electronic control, type MF-1 used on KC-135A aircraft, type MA-9, indicator, rate of flow and consumption, used on KC-135A aircraft, type MA-9 (PR 603637 and 603640), $173,571.

Kollsman Instrument Corp., Standard Coil Products Co., Inc., 80-08 45th Ave., Elmhurst, N. Y., type C-2A true airspeed and mach number computer for replacement spares, 44 ea. (PR MA 650005), $77,162.

The Leland Electric Co., American Machine & Foundry Co., 1501 Webster St., Dayton, Ohio, motor generators to support C-97C, C-54M, YC-121E, VC-118A, and C-121B acft, (PR SA-715403), $69,225.

Hughes Aircraft Co., Florence Ave. and Teale St., Culver City, Calif., interceptor aircraft & weapons control system, type AN/ASQ-25, (PR 630996), $10,000,000.

The National Cash Register Co., Main and K St., Dayton, Ohio, constant speed drives, applicable to the support of the F-101 aircraft, (PR 694398 and 694399), $1,867,838.

United States Gauge Div., American Machine & Metals, Inc., Sellersville, Pa., gages, pressure dial indicating, type ME-1, 994 ea.; gages, pressure dial indicating, type ME-1, 593 ea., (PR PE-708095), $28,280.

The Leland Electric Co., Div. of American Machine & Foundry, Dayton, Ohio, inverters, 250 VA (Instl) for support of H-34A aircraft, (PR PE-694341), $124,139.

Bendix Products Div., Bendix Aviation Corp., 401 Bendix Dr., South Bend 20, Ind., main brake assys. 12-½" for F-100D aircraft, (PR PE-7-03B-3089), $495,036.

Lockheed Aircraft Corp., Marietta, Ga., fabrication of one (1) structurally complete C-130A acft (minus control surfaces, vertical empennage and outer wing panels); conduct a 25000 cycle test program; monthly progress report and final reports, (PR PH-225739 and PH-205032), $880,445.

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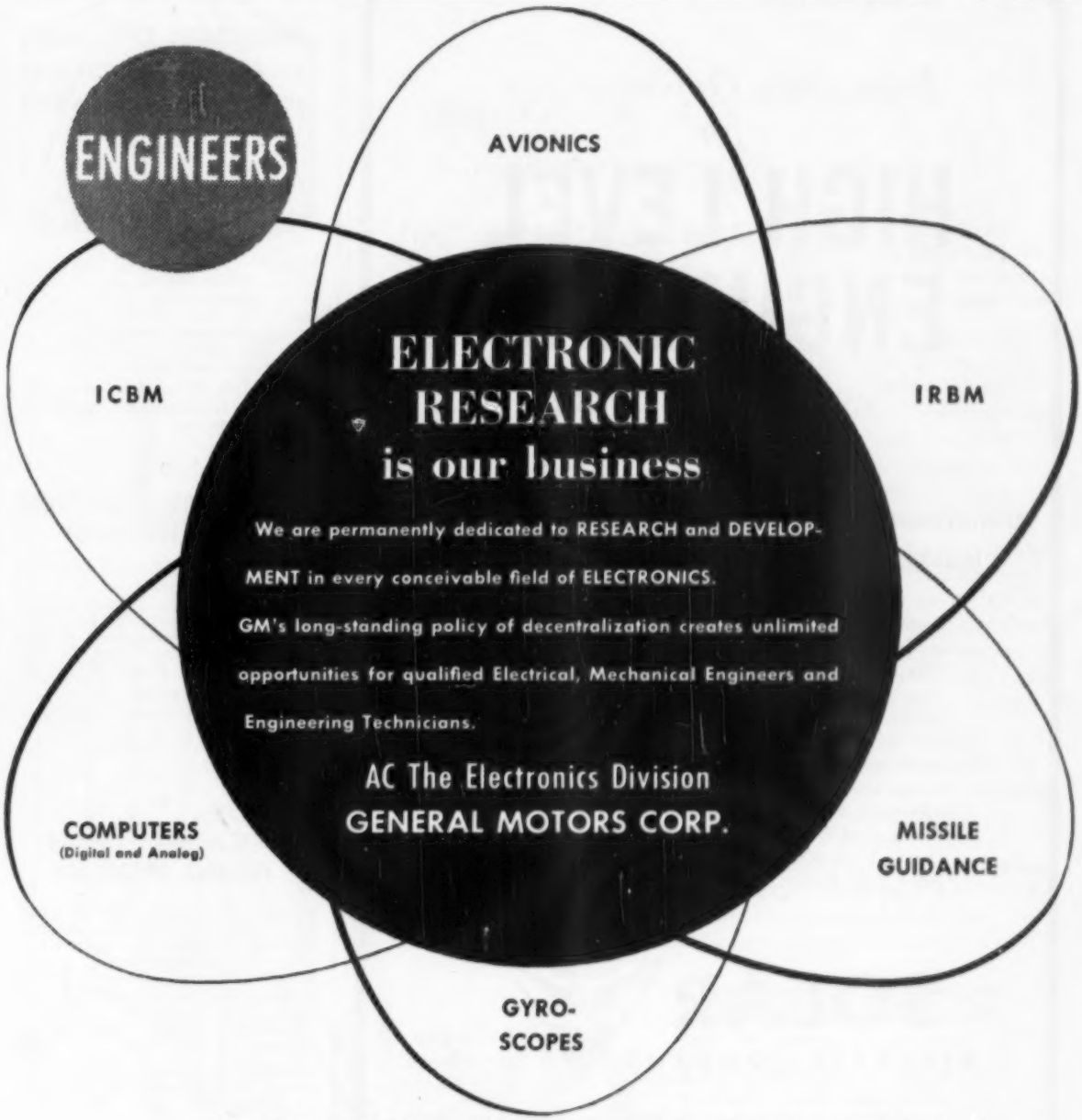
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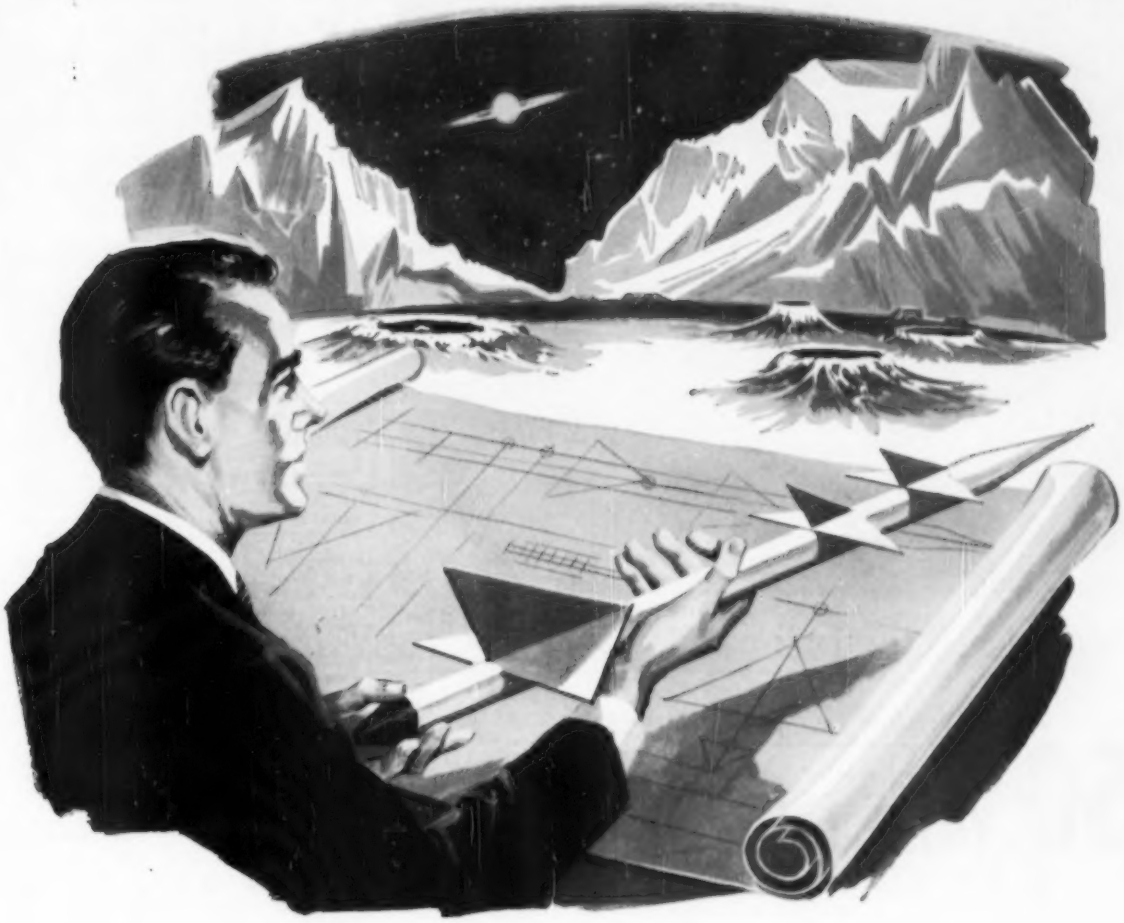

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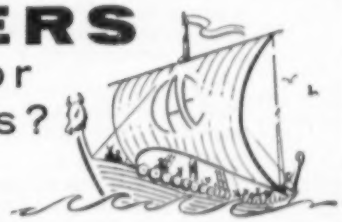

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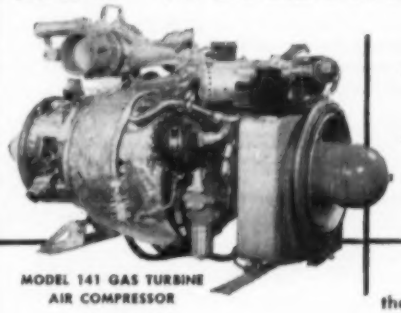

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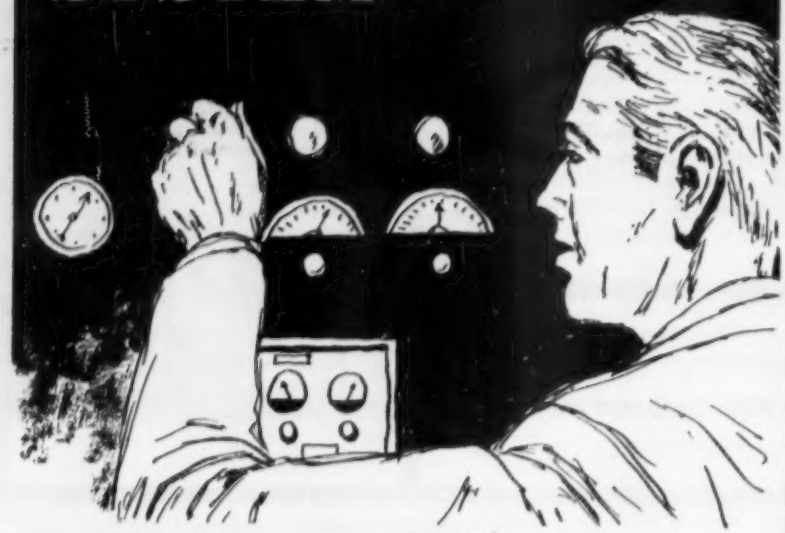

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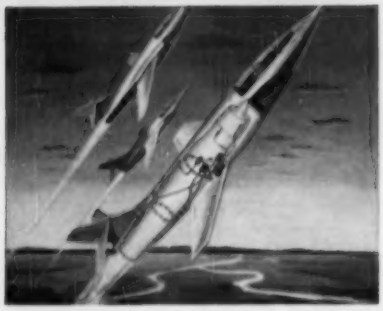

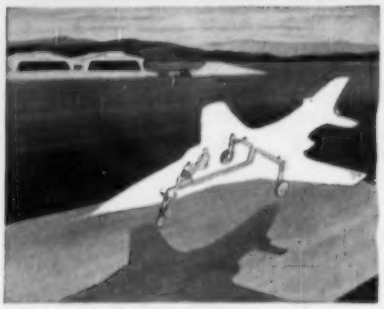

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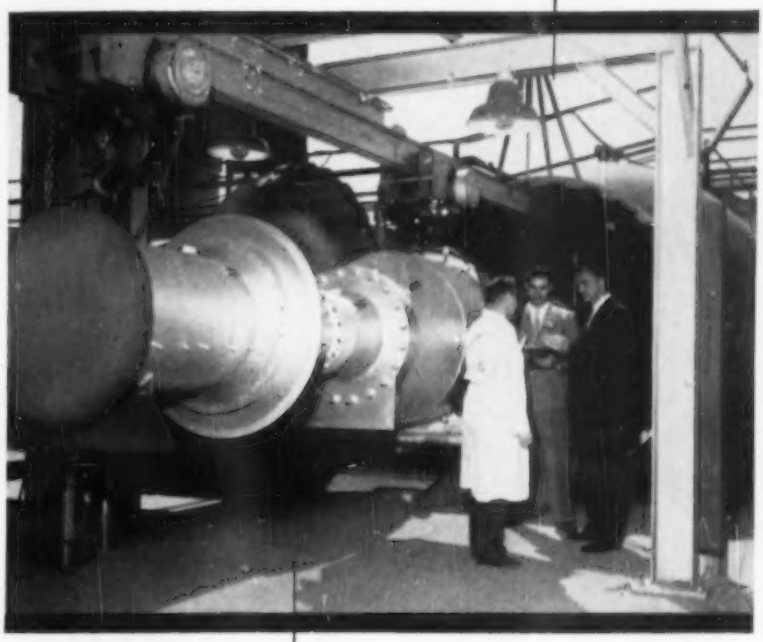

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LETTERS

Blimp Editorial

I would be remiss in my duty were I not to express by appreciation for your Editorial, "Navy's Blimps Perform," in AVIATION WEEK of March 25 (p. 21). The Wing subscribes to AW and your organization was thoughtful enough to send me a copy.

We who work hard with the blimps scattered along the Atlantic Coast in fleet operations—flying, maintaining, supporting, supplying hard-to-get parts, training personnel, rectifying design, etc.—are happy to read the too seldom references to the airship in technical publications available to the general public. We know too well that we are in the minority in the aviation picture, but we do know and are trying to prove again that the airship can solve a difficult problem in ASW and AEW when given the normal support that aviation receives in general from the public and within naval aviation.

Thanks again.

ALFRED L. COPE
Captain, U. S. Navy
Commander Fleet Airship Wing One
U. S. Naval Air Facility
Elizabeth City, N. C.

Infrared Value

I have been following your recent series of articles on Infrared (AW Mar. 4, p. 50; Mar. 11, p. 78; Mar. 18, p. 89) with a good deal of interest. The articles include good, down-to-earth material; the sort of information that most engineers would like to have. What is particularly gratifying is the fact that for the first time I have found a source of material that is unclassified and which contains specific information relating to fire control infrared systems.

A good deal of the information that you have published in your article has been distributed to me under the guise of being confidential, whereas I think you have clearly demonstrated that this information is not classified at all. All of this hush-hush transfer of information really acts to prevent development of a good infrared system, and I think you are to be congratulated for being brave enough to publish the information.

JOHN B. DAMONTE
Assistant Director of Research
Dalmo Victor Co.
Belmont, Calif.

STUB Meter

We wish to comment for the record on your news release in the Industry Observer column of your issue of April 1 (p. 23), concerning the STUB meter. This device for evaluating bonds in adhesively bonded construction was developed by Stanford Research Institute under contract with Wright Air Development Center. For over a year the aircraft industry has been cooperating in evaluating a laboratory version embodying the STUB meter principle. Eleven of these instruments are at present placed amongst cooperating manufacturers who are aiding in establishing operating and interpretation techniques. A version of the STUB meter has been offered for sale for the past year by Allen B. DuMont Laboratories, Clifton, N. J.

The U. S. Government has applied for the basic patents on the STUB meter and the various improvements which have been developed as a result of continuing research at Stanford Research Institute.

Since the Institute is concerned with the research portion of this work, it has made no attempt as yet to develop the individual instruments required for specific production line testing. Such special purpose versions have been devised by several in the aircraft industry and we are pleased to see the leadership taken by Convair in this regard. Since the improvement of the circuitry embodying the basic STUB meter principle is continuing, it is likely that no truly final version will be available for some time. The Institute and the Air Force will be glad to cooperate with any manufacturer who has specific production problems in the field for which the STUB meter was developed. We would also appreciate knowing of particular production testing experience and difficulties in which the large backlog of information we have gathered may be of use in advancing this means of nondestructive testing.

JAMES S. ARNOLD, Project Leader
Sonics Section
Stanford Research Institute
Menlo Park, Calif.

Aviation Week welcomes the opinion of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42 St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Consumers Union

The article entitled "Avionic Consumers Union Proposed," by Mr. Philip J. Klass, which appeared in the Jan. 28 issue (p. 100) of your magazine, was sincerely appreciated by our organization. We waited as long as we have to write this letter, so that we could give you a full report of the reactions we received after the magazine had an opportunity to circulate through the larger organizations and everyone had a chance to see it.

The article was exceptionally accurate in the facts presented, and the very philosophy of the program was captured and conveyed by Mr. Klass. I comment on these factors because the principles and concepts involved are completely new and without precedent to draw from in the field of electronics, therefore, a thorough understanding was necessary before the idea could be presented in your magazine. I have frequently found it difficult to convey our intentions, even to people deeply involved in the field of component part reliability.

We have received some forty-five direct inquiries which reference the article. But above and beyond this, we know that it was widely read. In several cases, the pages containing the article were removed from the magazine, reproduced and distributed within the organization which received it. In addition, since the article appeared, the great majority of people which I have contacted in my travels have commented in a manner indicating that they had thoroughly read Mr. Klass' article.

We are presently following through with a concrete program, and are soliciting potential subscribers. All indications are that we will obtain the required number of subscribers, and that the program will get under way.

We feel that the article which appeared in your Jan. 28 issue has played a very substantial part in bringing the program to the attention of the people in the avionics industry who are interested in, or responsible for, improving the reliability of military electronics equipment. These are the people which are responding most enthusiastically to the program.

G. G. BROWN, General Mgr.
Inland Testing Laboratories
Morton Grove, Ill.

Specht Critics Hit

We have noted with interest the letters to the editor which you printed in the April 15, 1957 issue of AVIATION WEEK dealing with the CAA's action against Captain Leonard Specht. We find this correspondence quite an amazing willingness of uninformed people seeking to prejudge an individual after having heard very sketchily one side of a case. The individuals writing AVIATION WEEK are willing to indict and convict one of their fellow men upon about as little knowledge of a situation as possessed by the representative of the Administrator when he embarked on his course of action against Captain Specht. I am wondering whether these same individuals would desire that they personally be exposed to the same legal process in their problems.

Basic principles involving the legal rights of an individual and the legal perogatives of a pilot to protect the passengers and property entrusted to him are involved in this case. A challenge is being made to the emergency authority of pilots, an authority which is basic to the safe conduct of a flight.

This action was taken by the Administrator under an emergency authority which completely denied Captain Specht any opportunity to defend himself or have an adequate investigation of the facts of the situation. In our view, it represents a totally irresponsible action of the part of the representatives of the Administrator beyond their legal rights and in utter disregard of the safety implications of such action. It is quite amazing to note the willingness of the writers to your column to share this irresponsibility.

CLARENCE N. SAYEN, President
Air Line Pilots Association
55th Street and Cicero Avenue
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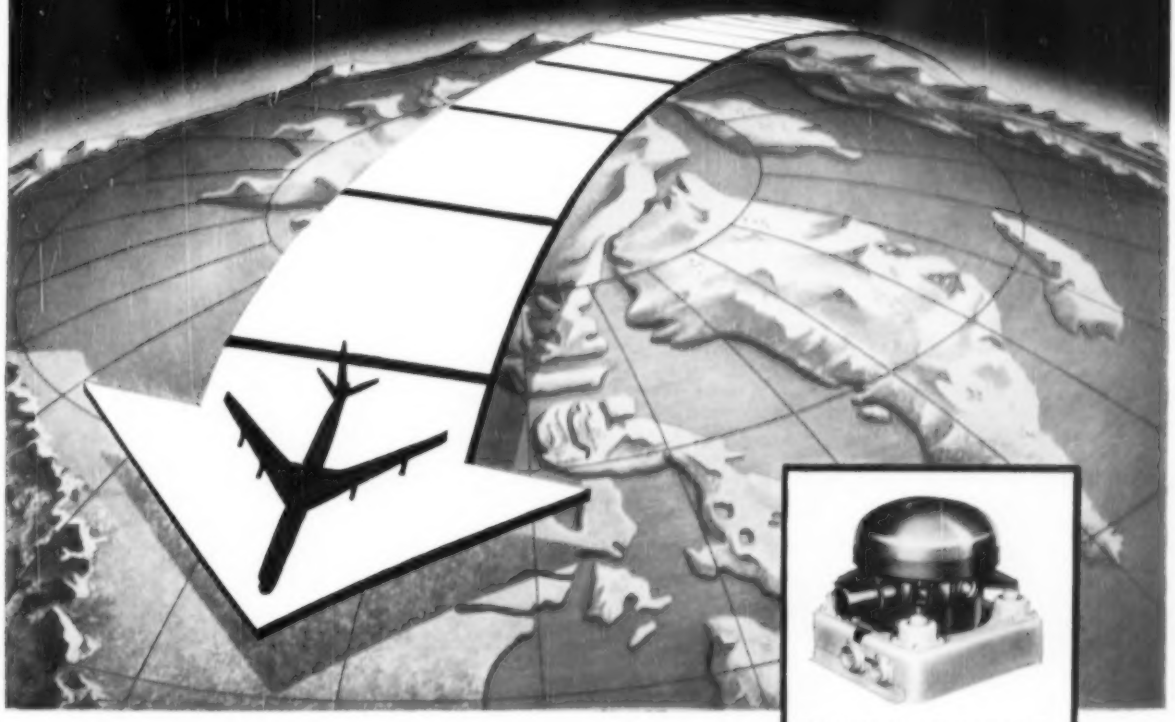

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